APPENDIX Q

MISCELLANEOUS INFORMATION

APPENDIX Q.1

CALCULATIONS RELATED TO SPECIALTY SAMPLES

Calculation of Possible Range of Mass of PCB Released During Wet Excavation

INPUT																
Dredging Rate, cu yd/hr	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
Dredging Schedule, hr/day	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
Dredging Schedule, days/week	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
Dredging Schedule, weeks/yr	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26
Water Content, wt water/wt solids	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Specific Gravity of Solids (assume 2.65)	2.65	2.65	2.65	2.65	2.65	2.65	2.65	2.65	2.65	2.65	2.65	2.65	2.65	2.65	2.65	2.65
Specific Gravity of Water	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Sediment PCB Concentration, mg/kg	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
Fraction of sediment < #200 sieve (2,7,15)	0.02	0.02	0.02	0.07	0.07	0.07	0.15	0.15	0.15	0.02	0.02	0.02	0.07	0.07	0.07	0.15
Fraction of sediment released at dredge (5,10,15)	0.05	0.10	0.15	0.05	0.10	0.15	0.05	0.10	0.15	0.05	0.10	0.15	0.05	0.10	0.15	0.05
Sediment PCB Conc. on fines, mg/kg	28.3	28.3	28.3	28.3	28.3	28.3	28.3	28.3	28.3	28.3	28.3	28.3	28.3	28.3	28.3	28.3
Stream discharge, cfs (100,70,40)	100	100	100	100	100	100	100	100	100	70	70	70	70	70	70	70
Added PCB Concentration, ug/L, at Woods Pond	0.03	0.05	0.08	0.09	0.18	0.27	0.20	0.39	0.59	0.04	0.07	0.11	0.13	0.26	0.39	0.28
Added TSS Concentration, mg/L, at Woods Pond	0.9	1.8	2.8	3.2	6.5	9.7	6.9	13.8	20.8	1.3	2.6	4.0	4.6	9.2	13.8	9.9
Mass PCB transported, g/cu yd dredged	**0.03**	**0.1**	**0.1**	**0.1**	**0.2**	**0.3**	**0.2**	**0.5**	**0.7**	**0.0**	**0.1**	**0.1**	**0.1**	**0.2**	**0.3**	**0.2**

Calculation of Possible Range of Mass of PCB Released During Wet Excavation

INPUT											
Dredging Rate, cu yd/hr	25	25	25	25	25	25	25	25	25	25	25
Dredging Schedule, hr/day	8	8	8	8	8	8	8	8	8	8	8
Dredging Schedule, days/week	6	6	6	6	6	6	6	6	6	6	6
Dredging Schedule, weeks/yr	26	26	26	26	26	26	26	26	26	26	26
Water Content, wt water/wt solids	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Specific Gravity of Solids (assume 2.65)	2.65	2.65	2.65	2.65	2.65	2.65	2.65	2.65	2.65	2.65	2.65
Specific Gravity of Water	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Sediment PCB Concentration, mg/kg	50	50	50	50	50	50	50	50	50	50	50
Fraction of sediment < #200 sieve (2,7,15)	0.15	0.15	0.02	0.02	0.02	0.07	0.07	0.07	0.15	0.15	0.15
Fraction of sediment released at dredge (5,10,15)	0.10	0.15	0.05	0.10	0.15	0.05	0.10	0.15	0.05	0.10	0.15
Sediment PCB Conc. on fines, mg/kg	28.3	28.3	28.3	28.3	28.3	28.3	28.3	28.3	28.3	28.3	28.3
Stream discharge, cfs (100,70,40)	70	70	40	40	40	40	40	40	40	40	40
Added PCB Concentration, ug/L, at Woods Pond	0.56	0.84	0.07	0.13	0.20	0.23	0.46	0.69	0.49	0.98	1.47
Added TSS Concentration, mg/L, at Woods Pond	19.8	29.7	2.3	4.6	6.9	8.1	16.1	24.2	17.3	34.6	51.9
Mass PCB transported, g/cu yd dredged	**0.5**	**0.7**	**0.0**	**0.1**	**0.1**	**0.1**	**0.2**	**0.3**	**0.2**	**0.5**	**0.7**

APPENDIX Q.2

DEWATERING CALCULATIONS

DEWATERING VOLUME CALCULATIONS

Objective: To determine the approximate volume of water that will be removed by gravity from excavated, saturated soil and sediment (see Figures 5.2-2 and 5.2-3).

Assumptions:
1) Based on preliminary field data, in situ sediment water content is approximately 20% and water drains by gravity to produce a sediment water content of approximately 12%
2) Bulk density of material after dewatering is 1.5 tons per cubic yard
3) Water drains from interstitial spaces, so no loss of volume occurs during dewatering
4) Volume of excavated material is 89,700 cubic yards (conservatively assumes all is saturated)
5) Excavated material will be transported by lined trucks to dewatering pads for water removal by gravity
6) An underdrain and pumping system will deliver drained water to holding tanks.

Material weight after dewatering = 89,700 x 1.5 = 134,550 tons

Dry weight of material = (1-0.12)(134,550) = 118,404 tons

Wet weight at excavation = (118,404)/(1-0.2) = 148,005 tons

Weight of water removed = (148,005)(0.2) - (134,550)(0.12) = 13,455 tons

Volume of water removed = (13,455 tons)(2,000 pounds/ton)(1 gallon/8.34 pounds)

= <u>3,226,600 gallons of water removed over project life</u>

Approximate daily volume of water generated:

(3,226,600)(300/89,700) = <u>10,790 gallons per day</u>

This rate is less than 8 gallons per minute based on a 24-hour day.

The pumping system will be designed for 100 gpm to handled initial surge of water when material is placed on the stockpile.

DEWATERING PAD SIZE CALCULATIONS

Objective: 1) Design pads with sufficient size to hold at least 100 cubic yards
2) Provide enough pads so that the holding time is sufficient to adequately dewater excavated material without impacting productivity

Assumptions: 1) Allow up to 3 days for dewatering (conservative)
2) Design for a maximum stockpile slope of 1V:2.5H for stability
3) Assume a maximum working height of 8 ft for stockpiled materials
4) Assume a conical or pyramid stockpile shape
5) Assume average daily excavation rate of 300 cubic yards per day.

then, using the 8-ft maximum height:

Stockpile base must be at least 8 x 2.5 x 2 = 40 ft

Volume of stockpile = (100 cubic yards)(27 cubic yard) = (1/3)(area of base)(8)
(area of base) = 8100/(8) = 1,012.5

if stockpile is conical:
(area of base) = (B)(r)^2 = 1,012.5
r = 18 ft diameter = 36 ft

if stockpile is a pyramid:
(area of base) = (base)(width) = 1,012.5
if base = width,
base = width = 32 ft

Design for 40-ft by 40-ft pads to achieve slope stability with 8-ft maximum height

Volume of stockpile (max) = (1/3)(40)(40)(8)(1/27) = 150 cubic yards (if a pyramid), or
(1/3) (B)(r)^2(8)(1/27) = 120 cubic yards (if conical)

Therefore, with a 40-ft by 40-ft dewatering pad, stockpile capacity will be 100 to 150 cubic yards when maximum height is 8-ft.

No more than three dewatering pads will be required to dewater each days' excavation volume. (Larger pad capacity of up to 150 yd^3. Provides safety factor for higher excavation rates.)

With three pads required per day and if 3 days' dewatering is needed, at least nine dewatering pads will be required. Plan for 12 pads so that excavated material from day 4 can be stockpiled without having to remove previously stockpiled material first.

Design Conclusion:

Provide 12 dewatering pads, each 40 ft by 40 ft with a maximum height of 8 ft.

APPENDIX Q.3

WASTE DISPOSAL VOLUME CALCULATIONS

GE EE/CA

Alternatives 1, 2, and 3
Disposal Option A (Consolidation at GE Facility and Off Site Disposal of Balance)
Waste Characterization Volumes

Waste Category	Sediment Volume (yd^3)	Riverbank Volume (yd^3)	Total Volume (yd^3)	Total Weight (tons)*
Consolidation at GE Bldg 71	5,000	20,000	25,000	37,500
Consolidation at GE Hill 78	12,500	12,500	25,000	37,500
RCRA C Waste (lead only)	0	0	0	0
RCRA D Remediation Waste	25,700	14,000	39,700	59,550
TSCA Waste	0	0	0	0
Subtotal	43,200	46,500	89,700	134,550
Chipped clean vegetation (clear and grub operations)				250
Residuals disposal (filters, carbon, PPE)				100

NOTES: * Conversion factor of 1.5 tons per yd^3

GE EE/CA

Alternatives 1, 2, and 3
Disposal Option B (Off Site Disposal)
Waste Characterization Volumes

Waste Category	Sediment Volume (yd^3)	Riverbank Volume (yd^3)	Total Volume (yd^3)	Total Weight (tons)*
RCRA C Waste (lead only)	1,300	1,500	2,800	4,200
RCRA D Remediation Waste	38,400	36,400	74,800	112,200
TSCA Waste	3,500	8,600	12,100	18,150
Subtotal	43,200	46,500	89,700	134,550
Chipped clean vegetation (clear and grub operations)				250
Residuals disposal (filters, carbon, PPE)				100

NOTES: *Conversion factor of 1.5 tons per yd^3

GE EE/CA

Alternatives 1, 2, and 3
Thermal Desorption and Solvent Extraction Treatment Options (C and D)
Waste Characterization Volumes After Treatment

Waste Category	Sediment Volume (yd^3)	Riverbank Volume (yd^3)	Total Volume (yd^3)	Total Weight (tons)*
RCRA C Waste (lead only)[4]	1,300	1,500	2,800	4,200
RCRA D Remediation Waste	4,300	6,200	10,500	15,750
TSCA Waste	0	0	0	0
Landfill Cover	37,600	38,800	76,400	114,600
Subtotal	43,200	46,500	89,700	134,550
Chipped clean vegetation (clear and grub operations)				250
Residuals disposal (filters, carbon, PPE)				20
Liquid PCB residuals (2,000 gallons)				100

NOTES: * Conversion factor of 1.5 tons per yd^3

APPENDIX Q.4

DREDGING ELUTRIATE RESULTS

Dredging Elutriate Results

	Dredging Elutriate Results					
Field Sample ID	H2-SE000011-0-0005A1	H2-SE000011-0-0005A2	H2-SE000011-0-0005B1	H2-SE000011-0-0005B2	H2-SE000011-0-0005A3	H2-SE000011-0-0005B3
Date Collected	1/20/99	1/20/99	1/20/99	1/20/99	1/20/99	1/20/99
Depth	0.0-0.0	0.0-0.0	0.0-0.0	0.0-0.0	0.0-0.0	0.0-0.0
Analyte						
INORGANICS						
TOC (mg/L)	NA	NA	NA	NA	NA	NA
PCBs						
PCB, TOTAL (ug/L)	0.44	4.6	NA	NA	1.1	NA
PCBs - FILTERED						
PCB, TOTAL (ug/L)	NA	NA	0.012	0.36	NA	0.014

PCB in sed,ug/g (1)	3.3	3.3	3.3	3.3	3.3	3.3
Total PCB in DRET test, ug/L(2)	33	33	33	33	33	33
Total %PCB released	1.3	14			3.3	
Soluble %PCB released			0.04	1.1		0.04
Mass released, g/yd^3 (3)	0.4	4.4			1.06	
Mass released, g/yd^3 (3)			0.01	0.35		0.01

(1) PCB concentration in sediment used for DRET test
(2) Based on addition of 10 g of wet sediment to the DRET vessel.
(3) Percent released in DRET test multiplied by the mean EE/CA reach PCB concentration at mean EE/CA reach dry density

Dredging Elutriate Results

	Dredging Elutriate Results					
Field Sample ID	H2-SE000018-0-0005A	H2-SE000018-0-0005B	H2-SE000021-0-0000A	H2-SE000021-0-0000B	H2-SE000022-0-0000A	H2-SE000022-0-0000B
Date Collected	1/21/99	1/21/99	1/22/99	1/22/99	1/22/99	1/22/99
Depth	0.0-0.0	0.0-0.0	0.0-0.0	0.0-0.0	0.0-0.0	0.0-0.0
Analyte						
INORGANICS						
TOC (mg/L)	NA	NA	NA	NA	NA	NA
PCBs						
PCB, TOTAL (ug/L)	13	NA	2.6	NA	130	NA
PCBs - FILTERED						
PCB, TOTAL (ug/L)	NA	0.086	NA	0.036	NA	2.3

PCB in sed,ug/g (1)	34	34	7.4	7.4	119	119
Total PCB in DRET test, ug/L(2)	338	338	74	74	1193	1193
Total %PCB released	3.8		3.5		11	
Soluble %PCB released		0.03		0.05		0.19
Mass released, g/yd^3 (3)	1.2		1.1		3.4	
Mass released, g/yd^3 (3)		0.01		0.02		0.06

(1) PCB concentration in sediment used for DRET test
(2) Based on addition of 10 g of wet sediment to the DRET vessel.
(3) Percent released in DRET test multiplied by the mean EE/CA reach PCB concentration at mean EE/CA reach dry density

Dredging Elutriate Results

	Dredging Elutriate Results			
Field Sample ID	H2-SE000025-0-0005A	H2-SE000025-0-0005B	H2-SE000032-0-0010A	H2-SE000032-0-0010B
Date Collected	1/28/99	1/28/99	1/28/99	1/28/99
Depth	0.0-0.0	0.0-0.0	0.0-0.0	0.0-0.0
Analyte				
INORGANICS				
TOC (mg/L)	NA	NA	NA	NA
PCBs				
PCB, TOTAL (ug/L)	4.2	NA	1.9	NA
PCBs - FILTERED				
PCB, TOTAL (ug/L)	NA	0.015	NA	0.013

PCB in sed,ug/g (1)	38	38	18	18
Total PCB in DRET test, ug/L(2)	379	379	177	177
Total %PCB released	1.1		1.1	
Soluble %PCB released		0.004		0.01
Mass released, g/yd^3 (3)	0.35		0.34	
Mass released, g/yd^3 (3)		0.001		0.002

(1) PCB concentration in sediment used for DRET test
(2) Based on addition of 10 g of wet sediment to the DRET vessel.
(3) Percent released in DRET test multiplied by the mean EE/CA reach PCB concentration at mean EE/CA reach dry density

APPENDIX Q.5

POREWATER RESULTS

Pore Water Results

	Pore Water Results							
Field Sample ID	H2-SE000018-0-0005C		H2-SE000025-0-0000D1		H2-SE000025-0-0000D2		H2-SE000032-0-0000E1	
Date Collected	1/21/99		1/28/99		1/28/99		1/28/99	
Depth	0.0-0.0		0.0-0.0		0.0-0.0		0.0-0.0	
Analyte								
TOC (mg/L)	40.2		21.9		NA		29.3	
PCB, TOTAL (ug/L)	1.9	J	11	J	16	J	6.8	J

Pore water was centrifuged from the wet sediment sample. There was no dilution. This concentration is equivalent to the concentration in water "leaking" from bucket during excavation. Assume range of PCB concentrations and water contents, and calculate the mass of PCB lost per 1,000 cy excavated.

		Minimum	Mid-range	Maximum
PCB concentration, ug/L		1.9	8.9	16
Water content, wt water/wt sediment (1)		0.08	0.18	0.32
Conversion factor, kg sediment/cy sediment (2)		1360		
Fraction of pore water lost from bucket		0.05	0.1	0.2
Mass of PCB lost mg/yd^3	Minimum	0.01		
	Maximum	1.4		
	Mid-range	0.22		
Mass of PCB lost, g/100,000 yd^3	Minimum	1.0		
	Maximum	139		
	Mid-range	22		

(1) Water content minimum, maximum and arithmetic mean for 28 EE/CA samples.

(2) Conversion factor based on bulk density of 111.2 pounds/cubic foot

APPENDIX Q.6

DURATION ASSUMPTIONS AND SCHEDULES

ASSUMPTIONS USED FOR DETERMINING ALTERNATIVE DURATIONS

Alternative 1 - Wet Excavation

- Mobilization/site setup requires approximately 7 weeks before excavation can start.
- Duration of excavation based on excavating 150 yd^3/day of riverbed sediments with 30% downtime (based on amount of time river is flowing in above-average condition). Duration is 43,225 yd^3/150 yd^3/day * 1.3 = 375 work days.
- Restoration of riverbed is assumed to follow 1 week behind wet excavation.
- Bank excavation performed at 300 yd^3/day, resulting in a total number of work days of 158 required, using a downtime of 5% to account for equipment/weather delays. Duration is 46,513 yd^3/ 300 yd^3/day *1.05 = 163 days.
- Bank excavation is not a critical path activity and will occur concurrently with sediment excavation with a delay of 1 week. Bank excavation will be conducted intermittently throughout the project, so overall duration will match the 375-day duration for sediment excavation.
- O&M of the truck decon facilities will be performed throughout bed and bank excavation.
- Characterization sampling will be performed throughout bed and bank excavation.
- Placement of riverbed backfill materials will lag behind riverbed excavation and will therefore have the same duration.
- Placement of bank fill material will lag behind bank excavation by 1 week and will have the same overall duration.
- Bank restoration will lag behind placement of bank fill material by 1 week and will have the same overall duration.
- Demobilization activities require 2 months to complete.

Alternative 2 - Sheetpile at Non-cobble Areas/Pumping Bypass at Cobble Areas

- Mobilization/site setup requires approximately 7 weeks before excavation can start.
- The overall duration for excavation is determined by adding the time it takes to complete the first six sheetpile cells (both sides of river), complete two pumping bypass setups, and then complete the remaining eight sheetpile cells.
- Setup of the first pumping bypass cell occurs concurrently with completion of the last sheetpile cell, to allow continuous excavation.

- Completion of the last pumping bypass section will occur concurrently with setup of the next sheetpile cell, to allow continuous excavation.

- Each sheetpile cell requires 39 days to complete. This includes 11 days of sheetpile installation, 9 days of excavation, 7 days of backfill, 8 days of sheetpile removal, and 4 days of downtime at 10%.

- Sheetpile excavation is based on approximately 2,300-yd^3 sediments per sheetpile cell and 250 yd^3/day excavation rate and 300 yd^3/day backfill rate.

- Fourteen 400-ft cells for sheetpile are included. Duration is 39 x 14 = 564 days.

- Each pumping bypass requires approximately 69 days to complete. This includes 40 days to setup/breakdown/move the system, 22 days excavation/backfill (includes lag), and 7 days of downtime (30% of excavation/backfill time). Excavation/backfill rate is 300 yd^3/day.

- Two 1,050-ft cells are included for pumping bypass. Duration is 69 x 2 = 138 days.

- Total duration for sediment excavation is 640 days with concurrent work in sheetpile areas and bypass areas.

- Bank excavation performed at 300 yd^3/day, resulting in a total number of work days of 158 required, using a downtime of 5% to account for equipment/weather delays. Duration is 46,513 yd^3 / 300 yd^3/day *1.05 = 163 days.

- Bank excavation is not a critical path activity and will occur concurrently with sediment excavation with a delay of 1 week. Bank excavation will be conducted intermittently throughout the project, so overall duration will match the 640-day duration for sediment excavation.

- O&M of the truck decon facilities will be performed throughout bed and bank excavation.

- Characterization sampling will be performed throughout bed and bank excavation.

- Placement of riverbed backfill materials will lag behind riverbed excavation and will therefore have the same duration.

- Placement of bank fill material will lag behind bank excavation by 1 week and will have the same overall duration.

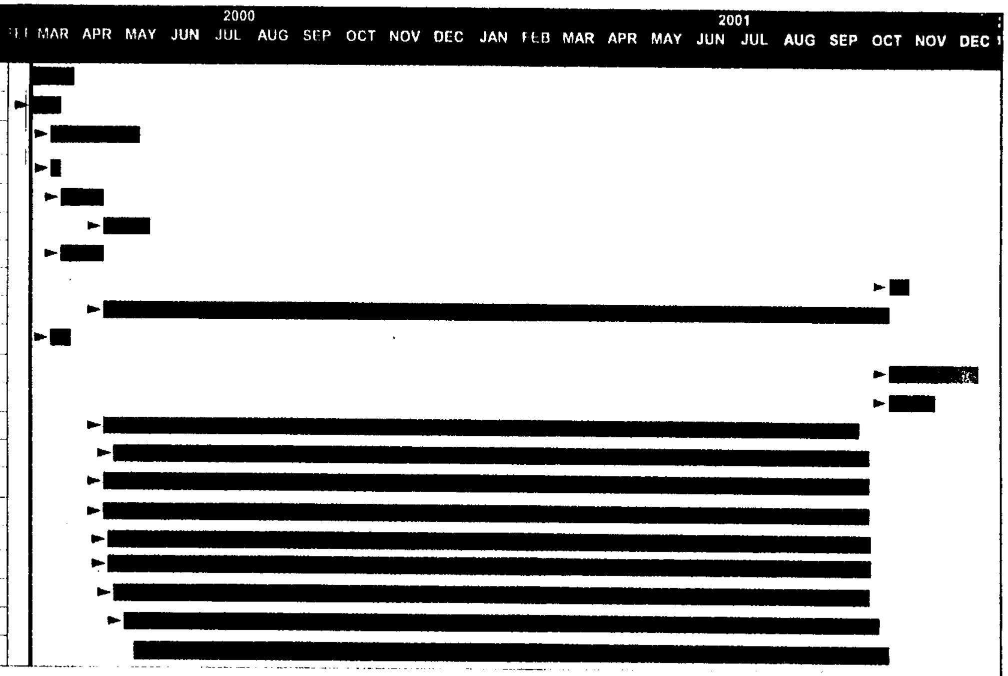
- Bank restoration will lag behind placement of bank fill material by 1 week and will have the same overall duration.

- Demobilization activities require 2 months to complete.

Alternative 3 - Pumping Bypass Entire EE/CA Reach

- Mobilization/site setup requires approximately 7 weeks before excavation can start.
- The overall duration for excavation is determined by adding the time it takes to complete the five pumping bypass setups. Each setup is 1,500 ft in river length.
- Each pumping bypass requires approximately 83 days to complete. This includes 40 days to setup/breakdown/move the system, 33 days excavation/backfill (29 days plus 4 days lag), and 10 days of downtime (30% of excavation/backfill time). Excavation/Backfill rate is 300 yd^3/day.
- Five 1,500-ft cells are included for pumping bypass. Duration is 83 x 5 = 415 days.
- Bank excavation performed at 300 yd^3/day, resulting in a total number of work days of 158 required, using a downtime of 5% to account for equipment/weather delays. Duration is 46,513 yd^3/300 yd^3/day *1.05 = 163 days.
- Bank excavation is not a critical path activity and will occur concurrently with sediment excavation with a delay of 1 week. Bank excavation will be conducted intermittently throughout the project, so overall duration will match the 415-day duration for sediment excavation.
- O&M of the truck decon facilities will be performed throughout bed and bank excavation.
- Characterization sampling will be performed throughout bed and bank excavation.
- Placement of river bed backfill materials will lag behind river bed excavation and will therefore have the same duration.
- Placement of bank fill material will lag behind bank excavation by 1 week and will have the same overall duration.
- Bank restoration will lag behind placement of bank fill material by 1 week and will have the same overall duration.
- Demobilization activities require 2 months to complete.

Description	Rem Dur	Early Start	Early Finish
setup temporary facilities	22	03/01/00 *	03/30/00
Install Temporary Fence	15	03/01/00	03/21/00
Construct temporary dewatering area	44	03/15/00	05/15/00
Temporary Dewatering Area WTS	5	03/15/00	03/21/00
Erosion and Sedimentation Control	22	03/22/00	04/20/00
Clearing	22	04/21/00	05/22/00
Temporary Access Road	22	03/22/00	04/20/00
remove Temporary access road	10	10/19/01	11/01/01
Maintenance and Protection of Traffic	390	04/21/00	10/18/01
Truck Decon Facilities	10	03/15/00	03/28/00
Demobilization	44	10/19/01	12/19/01
Pavement Restoration	22	10/19/01	11/19/01
Excavate Bed Sediments (inc. 30% down time)	375	04/21/00	09/27/01
Excavate Bank Soils	375	04/28/00	10/04/01
O&M Truck Decon Facilities	380	04/21/00	10/04/01
Manage Drying Area	380	04/21/00	10/04/01
O&M WTS	380	04/24/00	10/05/01
Characterization Sampling	380	04/24/00	10/05/01
Import/Place River Bed Backfill (inc. 30% dt)	375	04/28/00	10/04/01
Import and place fill material / Bank	375	05/05/00	10/11/01
Bank Restoration	375	05/12/00 *	10/18/01



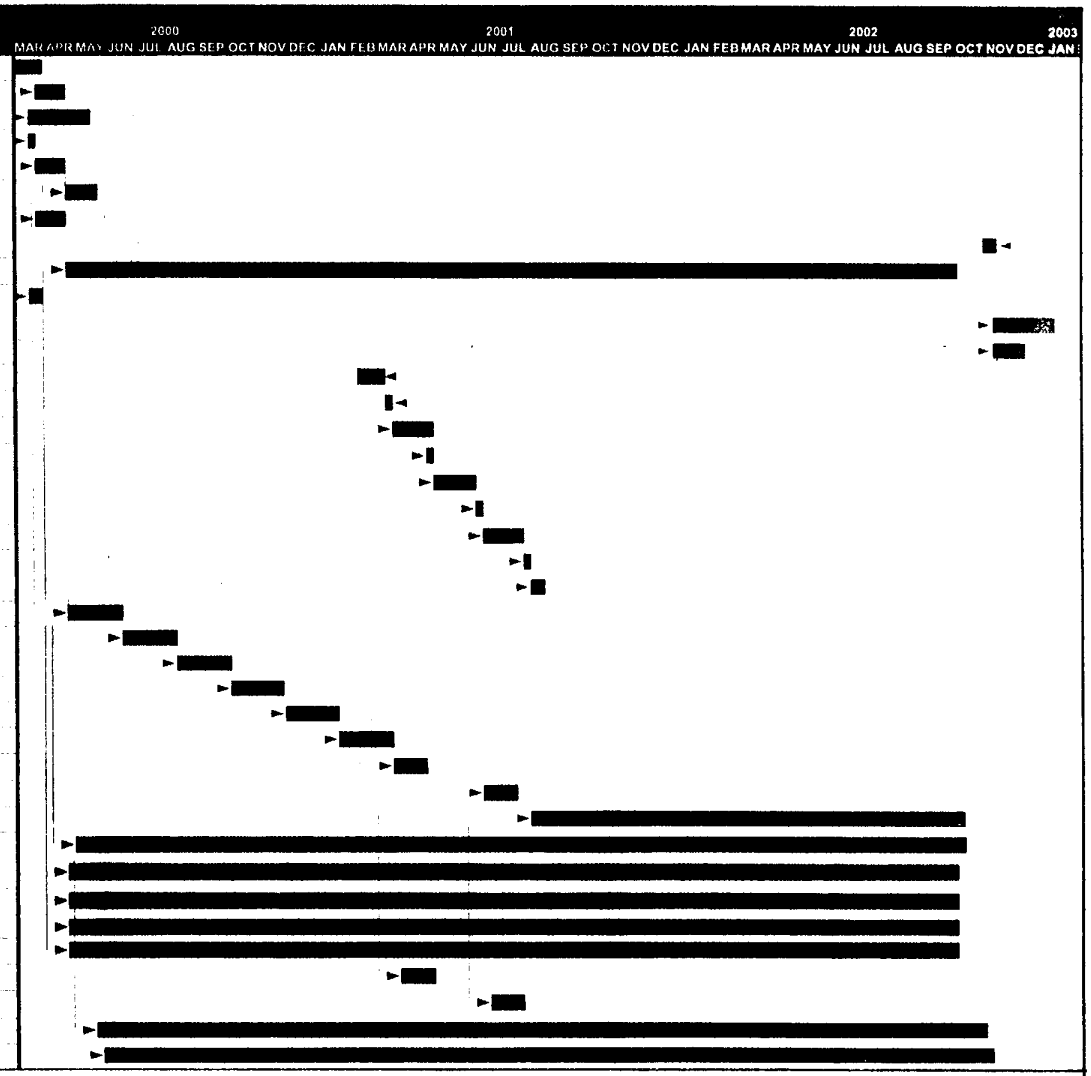
Start date	12/07/99
Finish date	12/19/01
Data date	03/01/00
Run date	12/16/99
Page number	1A

Pittsfield EE/CA Alternative 1
West Excavation

This schedule has been developed for cost/duration estimating purposes only. The start date shown is not a proposed start date and is used only for purposes of determining durations. The actual start date will be different and will depend on many factors.

Early bar
Progress bar
Critical bar
Summary bar
Progress point
Critical point
Summary point
Start milestone point
Finish milestone point

Description	Rem Dur	Early Start	Early Finish
setup temporary facilities	20	03/01/00 *	03/28/00
Install Temporary Fence	22	03/22/00 *	04/20/00
Construct temporary dewatering area	44	03/15/00	05/15/00
Temporary Dewatering Area WTS	5	03/15/00	03/21/00
Erosion and Sedimentation Control	22	03/22/00	04/20/00
Clearing	22	04/21/00	05/22/00
Temporary Access Road	22	03/22/00	04/20/00
remove Temporary access road	10	10/29/02	11/11/02
Maintenance and Protection of Traffic	640	04/21/00	10/03/02
Truck Decon Facilities	10	03/15/00	03/28/00
Demobilization	44	11/08/02	01/08/03
Pavement Restoration	22	11/08/02	12/09/02
Setup Pumping Bypass system no 1	20	02/08/01	03/07/01
Setup Diversion Dams 1	5	03/08/01	03/14/01
O&M Bypass system set up 1	29	03/15/01	04/24/01
Tear down diversion dams 1	5	04/18/01	04/24/01
Tear Down PB 1/ setup PB 2	30	04/25/01	06/05/01
Setup Diversion Dams 2	5	06/06/01	06/12/01
O&M Bypass system set up 2	29	06/13/01	07/23/01
Tear down diversion dams 2	5	07/24/01	07/30/01
Tear Down PB 2	10	07/31/01	08/13/01
sheetpile/exc/backfill section 1	39	04/21/00	06/14/00
sheetpile/exc/backfill section 2	39	06/15/00	08/08/00
sheetpile/exc/backfill section 3	39	08/09/00	10/02/00
sheetpile/exc/backfill section 4	39	10/03/00	11/24/00
sheetpile/exc/backfill section 5	39	11/27/00	01/18/01
sheetpile/exc/backfill section 6	39	01/19/01	03/14/01
Excavate cobble reach sediments 1	24	03/15/01	04/17/01
Excavate cobble reach sediments 2	24	06/13/01	07/16/01
SP/exc./back/sec 7-14 (inc. 10% down)	312	07/31/01	10/09/02
Excavate Bank Soils	640	04/28/00 *	10/10/02
O&M Truck Decon Facilities	640	04/21/00	10/03/02
Manage Drying Area	640	04/21/00	10/03/02
O&M WTS	640	04/21/00	10/03/02
Characterization Sampling	640	04/21/00	10/03/02
Place River Bed Backfill cobble reach 1	24	03/22/01	04/24/01
Place River Bed Backfill cobble reach 2	24	06/20/01	07/23/01
import and place fill material / Bank	640	05/19/00	10/31/02
Bank Restoration	640	05/26/00	11/07/02



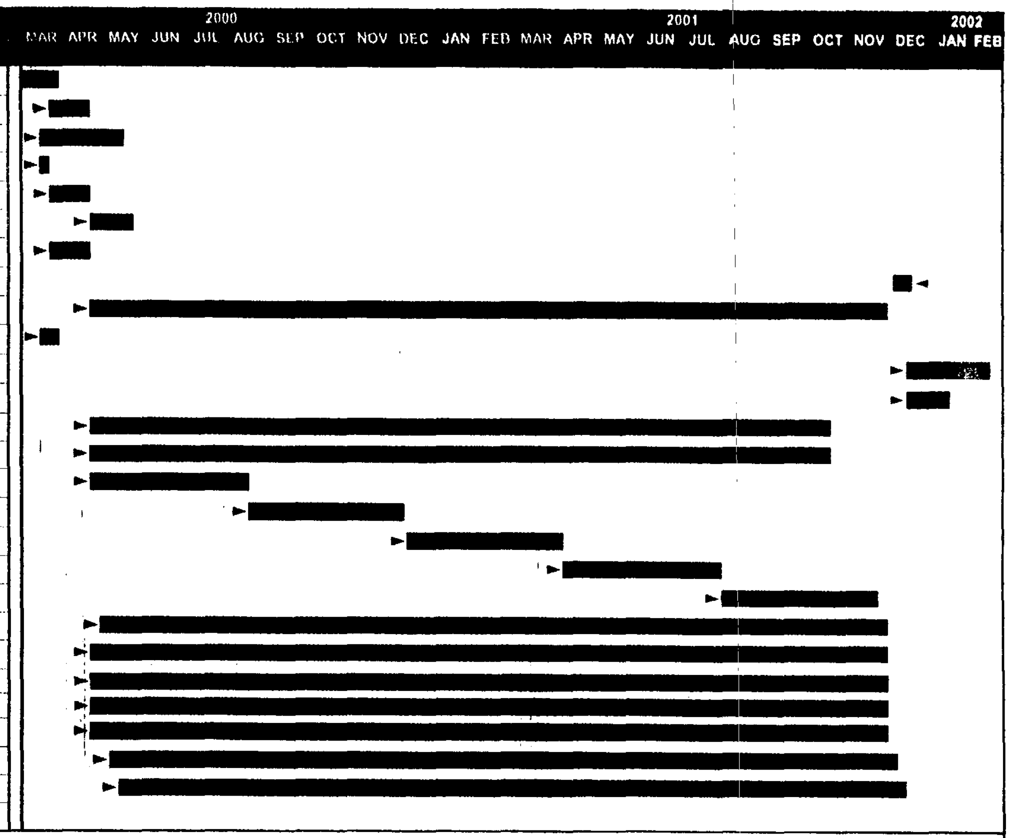
Start date 12/07/99
Finish date 01/08/03
Data date 03/01/00
Run date 12/16/99
Page number 1A

Pittsfield EE/CA Alternative 2
Sheetpile/Pumping Bypass at Cobble Subreaches

This schedule has been developed for cost/duration estimating purposes only. The start date shown is not a proposed start date and is used only for purposes of determining durations. The actual start date will be different and will depend on many factors.

Early bar
Progress bar
Critical bar
Summary bar
▲ Progress point
▼ Critical point
Summary point
Start milestone point
Finish milestone point

Description	Rem Dur	Early Start	Early Finish
setup temporary facilities	20	03/01/00 *	03/28/00
Install Temporary Fence	22	03/22/00 *	04/20/00
Construct temporary dewatering area	44	03/15/00	05/15/00
Temporary Dewatering Area WTS	5	03/15/00	03/21/00
Erosion and Sedimentation Control	22	03/22/00	04/20/00
Clearing	22	04/21/00	05/22/00
Temporary Access Road	22	03/22/00	04/20/00
remove Temporary access road	10	12/04/01	12/17/01
Maintenance and Protection of Traffic	420	04/21/00	11/29/01
Truck Decon Facilities	10	03/15/00	03/28/00
Demobilization	44	12/14/01	02/13/02
Pavement Restoration	22	12/14/01	01/14/02
Dewatering of River Bed	390	04/21/00	10/18/01
O&M Seepage WTS	390	04/21/00	10/18/01
pump bypass/exc/backfill sec 1	83	04/21/00	08/15/00
pump bypass/exc/backfill sec 2	83	08/16/00	12/08/00
pump bypass/exc/backfill sec 3	83	12/11/00	04/04/01
pump bypass/exc/backfill sec 4	83	04/05/01	07/30/01
pump bypass/exc/backfill sec 5	83	07/31/01	11/22/01
Excavate Bank Soils	415	04/28/00 *	11/29/01
O&M Truck Decon Facilities	420	04/21/00	11/29/01
Manage Drying Area	420	04/21/00	11/29/01
O&M WTS	420	04/21/00	11/29/01
Characterization Sampling	420	04/21/00	11/29/01
Import and place fill material / Bank	415	05/05/00	12/06/01
Bank Restoration	415	05/12/00	12/13/01
	1	03/01/00	03/01/00



Start date	12/07/99
Finish date	02/13/02
Data date	03/01/00
Run date	12/16/99
Page number	1A

Pittsfield EE/CA Alternative 3
Pumping Bypass Entire Reach

This schedule has been developed for cost/duration estimating purposes only. The start date shown is not a proposed start date and is used only for purposes of determining durations. The actual start date will be different and will depend on many factors.

- Early bar
- Progress bar
- Critical bar
- Summary bar
- ▲ Progress point
- ▼ Critical point
- Summary point
- Start milestone point
- Finish milestone point

APPENDIX Q.7

PROTECTIVENESS OF CLEANUP LEVELS FOR REMOVAL ACTIONS OUTSIDE THE RIVER-PROTECTION OF HUMAN HEALTH (EPA MEMORANDUM DATED 4 AUGUST 1999)

United States Environmental Protection Agency
Region I
One Congress Street, Suite 1100
Boston, MA 02114-2023

Memorandum

DATE: August 4, 1999

SUBJECT: Protectiveness of Cleanup Levels for Removal Actions Outside the River - Protection of Human Health

FROM: Ann-Marie Burke, Toxicologist
Technical Support Section, EPA Region 1 *AB*

TO: Richard Cavagnero, GE Project Leader *[signature]*
USEPA, Region 1

The purpose of this memorandum is to present an evaluation of the protectiveness of the cleanup levels (i.e., performance standards), for PCBs in soil in the Action Memorandum for Removal Actions Outside the River at the GE-Housatonic River Site, Pittsfield, Massachusetts and in the Action Memorandum for Allendale School, GE-Pittsfield/Housatonic River Site, Pittsfield, Massachusetts.

Subpart E of the National Contingency Plan (NCP)(Superfund), supplemented by Agency Guidance, establishes the criteria for determining when exposure levels are protective of human health. As noted in EPA's OSWER Directive 9355.0-30 "Role of the Baseline Risk Assessment in Superfund Remedy Selection Decisions," EPA uses a cancer risk range of 10^{-4} to 10^{-6} as a "target range" within which the Agency strives to manage risks. Although the Agency has expressed a clear preference for cleanups achieving the more protective end of the range (i.e. 10^{-6}), waste management strategies achieving reductions in site risks anywhere within the risk range may be deemed acceptable. As is noted in Subpart E, the *total* cancer risk attributed to the response goals (e.g., cleanup levels) should fall within a 10^{-4} to 10^{-6} lifetime excess cancer risk range. Thus if other contaminants of concern are detected in these areas, the cleanup levels of these contaminants and those presented below for PCBs must collectively meet EPA's target risk range.

In choosing cleanup levels for compounds having noncarcinogenic effects, it is EPA's policy to select a concentration of a compound at which adverse effects are unlikely to occur. The hazard quotient is the measure of the potential for noncancer effects. The hazard quotient is the ratio of the exposure dose of a single substance to a reference dose (RfD) for that substance. The RfD attempts to establish a level of exposure below which there is a high degree of confidence that no effects will occur. Since the actual observed effects occur at significantly higher doses than an RfD value, we assume that the threshold of effects is somewhere between the estimated RfD and the Lowest Observable Effect Level (LOEL). Because of the conservatism built into the RfD an exposure that is only slightly above an RfD value does not signify that adverse effects are likely to occur. Rather for exposures close to an RfD it is reasonable to assume that it is generally unlikely that adverse effects would occur. Likewise a HQ slightly above one does not indicate adverse effects will occur. Based on the above, the cleanup levels for PCBs are protective of the most sensitive receptor for each exposure area as defined below.

The following table shows the calculated excess cancer risk and hazard quotient associated with the cleanup level for each exposure area of the site.

Areas	Cleanup Level (ppm)	Depth (ft)	Excess Cancer Risk	Hazard Quotient
Recreational	10	0-1	$7x10^{-6}$	1.4
Recreational	15	1-3	NC	NC
Industrial (surface)	25	0-1	$6x10^{-6}$	0.4
Indust.(subsurface)	200	1-6	$1x10^{-5}$	0.9
Residential	2	0-15	$4x10^{-6}$	0.8
Allendale School	2	0-15	$4x10^{-6}$	0.8

NC - not calculated; see qualitative discussion below

1. Recreational Areas 0-1ft (10 ppm)

This cleanup level applies to any area of the Site in which the current or future use is recreational. This includes areas in which there may by a playground, a ballfield, a bike path, a picnic area, a scenic walkway, etc. A daycare scenario is not considered in deriving this cleanup level since this use does not typically occur in recreational settings. Since the actual activity which will occur in each area of the Site designated as "recreational" is unclear, this cleanup level is protective of the recreational use which is likely to result in the greatest exposure to the most sensitive receptor. Thus the cleanup level of 10 ppm for PCBs in soil is protective of a young child visiting a playground. For other recreational areas in which less exposure occurs to less sensitive individuals, this cleanup level is lower and more protective than the Agencies would typically set. However, due to the uncertainty about future exposures, one cleanup level has been chosen for all recreational areas. Choosing one cleanup level which is protective of the most sensitive receptor for all recreational scenarios provides a simplified yet reasonable and protective approach for soil cleanup.

In estimating noncancer hazards and excess cancer risks associated with this, cleanup level it is assumed that a child (ages 1-13) visits the playground 3 days per week for 7 months of the year

(May through November) when the ground is not frozen or covered with snow. It is also assumed that a child's head, lower arms, hands, lower legs and feet could be exposed to contaminated soil during the warmer months (from May through September) and that in the colder months (from October through November) a child's head and hands could be exposed.

<u>Estimated noncancer hazard associated with oral and dermal exposure to recreational soils</u>

$$HQ = C_s x F x D \left[\left(\frac{1}{(BW_C x AT_{nc}) RfD_o} x \frac{IR_c x FI x ABS_o}{10^6 mg/kg} \right) + \left(\frac{1}{RfD_o} x \frac{[((AF_1 x SA_1 x 5)+(SA_2 x AF_2 x 2))/7] x ABS_d}{10^6 mg/kg} \right) \right]$$

HQ = hazard quotient
C_s = PCB concentration in soil, (i.e., cleanup level) (10mg/kg)
F = exposure frequency; (84dys/yr)=3dys/wkx4wks/mos 7mos/yr, (May-Nov); site-specific
D = duration;(6 yrs); Site-specific
IR_c= soil ingestion rate for child 1-6; 200mg/dy; EPA, 1991
FI = fraction ingested from site; (0.5); site-specific
ABS_o = GI absorption fraction; (1); PTI, 1993
SA_1 = surface area of a child exposed during May thru Sept = head, hands, lower arms, lower legs and feet; for child 1-6 =2900 cm^2 ;EPA, 1997; Based on;

- Mean fraction total SA for child obtained from Table 6-8, (EPA, 1997)
- Total SA determined by averaging 50th percentile SA by body part for males/females of appropriate age groups, from Table 6-6 and 6-7 (EPA, 1997)
- Due to lack of data for the indicated ages, assumed <1 and 1<2 year olds had the same total SA as 2>3 year olds
- Assumed forearm-to-arm ratio (0.45) and lower leg-to-leg ratio (0.4) equivalent to an adult.

AF_1 = overall skin adherence factor weighted by body-part exposed;
<u>For child 1-6 = 0.24mg/cm² -event:</u>

- data from Kissel et. al, 1998., (children playing in dry soil)
- No AF was available for feet or head so overall AF based on AFs for face, forearms, hands and lower legs. However, SA in equation for HQ based on SA of all exposed body parts. Thus feet AF assumed by default to have same amount of soil adhered as weighted AF.
- Used 95th percentile for AF for each body part exposed which resulted in a 95th percentile overall skin adherence factor (mg/cm^2).

$$AF_1(child_{1-6}) = \frac{(AF_{face})(SA_{face})+(AF_{forearms})(SA_{forearms})+(AF_{hands})(SA_{hands})+(AF_{lowerlegs})(SA_{lowerlegs})}{(SA_{face})+(SA_{forearms})+(SA_{hands})+(SA_{lowerlegs})}$$

$$= \frac{(326)(0.022)+(393)(0.135)+(358)(0.413)+(650)(0.329)}{326 + 393 + 358 + 650} = 0.24$$

SA_2= surface area for a child exposed during Oct thru Nov. = head and hands;
= 1340 cm^2 for 1-6 yr old
AF_2= overall skin adherence factor weighted by body part exposed from Oct thru Nov

AF_2 (child $_{1-6)}$ = $\frac{(326)(0.022)+(358)(0.413)}{326(face) + 358}$ = 0.23

ABS_d = dermal absorption fraction; (0.14), Wester et. al, 1993
BW = average body weight; 15 for 1-6yr old (EPA, 1997)
AT_{nc} = averaging time, 6yrsx365dys/yr - (2190 dys); Site-specific
RfD = reference dose for Aroclor 1254 = $2x10^{-5}$ mg/kg-dy; IRIS, 1998
Substituting the values above into the equation:

$$THQ = \frac{10x\ 84\ x6}{[15x2190]}\ [\frac{(1}{2x10^{-5}}\ x \frac{200\ x\ 0.5)}{10^6} + \frac{(1}{2x\ 10^{-5}}\ x\ \frac{[((2900x\ 0.24\ x\ 5)+(1340\ x0.23\ x\ 2))/7]x\ 0.14}{10^6}\ ]$$

$$= \frac{5040}{(32850)}\frac{(100}{20} + \frac{[((3480)+(616.4))/7]\ x0.14)}{20} = 45845.8/32850 = 1.4$$

<u>Estimated excess cancer risk associated with oral and dermal exposure to recreational soils</u>

$$ELCR = \frac{C_s\ x\ F\ [(CSFxABS_o x\ IF_{adj}) + (SFS_{adj}\ x\ CSFx\ ABS_d)]}{AT_c\ x\ 10^6\ mg/kg}$$

<u>Where;.</u>
ELCR = excess lifetime cancer risk
C_s = PCB concentration in soil, (i.e., cleanup level)(10mg/kg)
F = exposure frequency; (84dys/yr)=3dys/wkx4wks/mos 7mos/yr, (May-Nov); site-specific
CSF = cancer slope factor for PCBs (2 mg/kg-dy)$^{-1}$; IRIS, 1998
ABS_o = GI absorption fraction; (1); PTI, 1993
IF_{adj} = age- adjusted soil ingestion factor, equal to:

$$\frac{(FI)(IR_{1-6})(D_{1-6})}{BW_{1-6}} + \frac{(FI)(IR_{7-13})(D_{7-13})}{BW_{7-13}} = 40 + 8.2 = 48.2mg\text{-}yr/kg\text{-}dy$$

Where;
IR_c = soil ingestion rate; child 1-6; 200mg/dy; child 7-13; 100mg/dy; EPA, 1991
FI = fraction ingested from site; (0.5); site-specific
BW = average body weight; 15 for 1-6yr old; 36.8, based on average of mean body weights for boys/girls ages 7-13, from Table 7-3; EPA, 1997,
D = duration;(6 yrs); Site-specific
SFS_{adj} = age-adjusted soil contact factor=

$$\frac{(D_{1-6})[((AF_1\ x\ SA_1\ x\ 5)+(SA_2\ x\ AF_2\ x\ 2))/7]_{1-6}}{BW_{1-6}} + \frac{(D_{7-13})[((AF_1\ x\ SA_1\ x\ 5)+(SA_2\ x\ AF_2\ x\ 2))/7]_{7-13}}{BW_{7-13}}$$

$$= \frac{(6)[((0.24x2900x5)+(0.23x1340x2))/7]}{15} + \frac{(6)[((0.26x4276x5)+(0.26x1733x2))/7]}{36.8} = 384.5$$

Where;
SA_1 = surface area of a child exposed during May thru Sept = head, hands, lower arms, lower legs and feet; for child 1-6 =2900 cm^2 (see above), for child 7-13=4276 cm^2;EPA, 1997; Based on same assumptions as for SA_1 above (see noncancer calculations).
AF_1 = overall skin adherence factor weighted by body-part exposed;

For child 1-6 = 0.24mg/cm² -event(see above); For child 7-13:

- used same data and approach as for child 1-6 above. Surface area based on 7-13 yr old

AF_1 ($child_{7\text{-}13}$) = $\frac{(429)(0.022)+(633)(0.413)+(667)(0.135)+(1096)(0.329)}{429+633+667+1096} = 0.26$

AF_2 ($child_{1\text{-}6}$) = 0.23 mg/cm²-event(see above)

AF_2 ($child_{7\text{-}13}$) = (429)(0.22) + (633) (0.413) / (429) + 633 = 0.26

SA_2= surface area for a child exposed during Oct thru Nov. = head and hands;
1340 cm² for 1-6 yr old; 1733 cm ² for 7-13 yr old

ABS_d = dermal absorption fraction; (0.14), Wester et. al, 1993

AT_c = averaging time, 70yrsx365dys/yr - (25550days); Site-specific

Substituting the values above into the equation:

$$ELCR = \frac{10x84\ [(2x1x48.2) + (384.5\ x0.14\ x2)]}{(25550)(10^6 mg/kg)}$$

$$= \frac{840(96.4 + 107.7)}{25550x10^6} = \frac{171410.4}{25550x\ 10^6} = 6.7 \times 10^{-6}$$

Thus a 10 ppm cleanup level in recreational soils is associated with an excess cancer risk of $7x10^{-6}$ and a noncancer hazard of 1.4.

2. Recreational 1-3ft (15ppm)

A child at a playground is expected to be exposed to soils in the top foot. This is based on the typical activities which tend to occur in playgrounds and the expectation that an Environmental Restriction and Easement (ERE) will limit exposures at depth. However, since elevated concentrations of PCBs do exist below one foot in certain areas of the Site, an added measure of protection was selected to further reduce any possibility of exposure to the contaminated soils in the 1-3 foot interval. As a result, soils at the 1-3 foot depth will be cleaned up to a level of 15 ppm as an added measure of protection.

3. Commercial/Industrial 0-1ft (25 ppm)

For future commercial/industrial areas of the Site, the cleanup level has been set at 25 ppm. A daycare scenario is not considered in deriving this cleanup level since this use does not typically occur in industrial settings. Those individuals who are the most likely to receive the highest exposure to surface soils in these areas are groundskeepers who will be involved in activities such as gardening, mowing the lawn, sculpturing bushes, etc. In estimating noncancer hazards and excess cancer risks associated with this cleanup level, it is assumed that an groundskeeper works outdoors for 3 days per week for 7 months of the year (May through November) when the ground is not frozen or covered with snow. It is also assumed that a groundskeeper's head, forearms and hands are exposed to contaminated soil throughout this time.

Office workers could also be exposed to contaminated surface soil. However, their exposure is likely to be much lower than that of a groundskeeper. Thus the cleanup level for a groundskeeper should be protective for an office worker.

<u>Estimated noncancer hazard associated with oral and dermal exposure to a groundskeeper in industrial areas</u>

$$HQ = \frac{C_s \times F \times D}{(BW_a \times AT_{nc})}\left[\left(\frac{1}{RfD_o} \times \frac{IR_a \times FI \times ABS_{oral}}{10^6\ \text{mg/kg}}\right) + \left(\frac{1}{RfD_o} \times \frac{AF \times SA \times ABS_d}{10^6\ \text{mg/kg}}\right)\right]$$

<u>Where:</u>

HQ = hazard quotient

C_s = PCB concentration in soil, (i.e., cleanup level) (25mg/kg)

F = exposure frequency; (84dys/yr)–3dys/wkx4wks/mos 7mos/yr, (May-Nov); site-specific

D = duration;(25 yrs); EPA, 1991

IR_a = soil ingestion rate for adult worker; 50mg/dy; EPA, 1991

FI = fraction ingested from site; (1); professional judgement

ABS_{oral} GI absorption fraction; (1); PTI, 1993

SA = surface area of a groundskeeper exposed during May thru November = head, forearms and hands ($3300cm^2$)

- average of 50th percentile SA for body part of males/females > 18yrs
- Assume female adult forearm SA is 45% of the arm SA (based on info in males)

AF = overall skin adherence factor weighted by body part exposed($0.1mg/cm^2$ -event)

Based on gardener data from EPA, 1997, using the 50th% for the AF for each body part which results in an overall 50^{th} % AF. The AF dataset for a gardener was chosen because it represents a "high-end" activity for a groundskeeper. When using a high-end activity, the 50^{th} percentile for the AF best approximates the RME scenario, thus the choice of the 50^{th} % for the adherence factor.

ABS_d = dermal absorption fraction; (0.14), Wester et. al, 1993

BW = average body weight: 70kg (EPA, 1997)

AT_{nc} = averaging time, 25yrsx365dys/yr - (9125 dys); Site-specific

RfD – reference dose for Aroclor 1254 – $2x10^{-5}$ mg/kg-dy; IRIS, 1998

Substituting the values above into the equation:

$$HQ = \frac{25 \times 84 \times 25}{(70 \times 9125)}\left[\left(\frac{(1)}{2x10\text{-}5} \times \frac{(50 \times 1)}{10^6}\right) + \left(\frac{1}{2x\,10\text{-}5} \times \frac{(3300 \times 0.1 \times 0.14)}{10^6}\right)\right]$$

$$= \frac{52500}{638750}\left(\frac{50}{20} + \frac{46.2}{20}\right) = 0.4$$

Estimated excess cancer risk associated with oral and dermal exposure to groundskeeper in commercial areas

$$ELCR = \frac{C_s \times F \times D \times CSF\,[(ABS_o \times IR \times FI) + (SA \times AF \times ABS_d)]}{BW \times AT_c \times 10^6\ mg/kg}$$

See above for additional definition and values of terms;
At_c = averaging time, 70yrsx365dys/yr - (25550 dys); EPA, 1991
CSF = cancer slope factor for PCBs (2 mg/kg-dy)$^{-1}$; IRIS, 1998
Substituting into this equation;

$$ELCR = \frac{25 \times 84 \times 25 \times 2\ [(1)(50) + (0.1 \times 0.14 \times 3300)]}{(70)(25550)(10^6 mg/kg)}$$

$$= \frac{105000\ (50+46.2)}{1788500 \times 10^6}$$

$$= \frac{10101000}{1788500 \times 10^6} = 5.6 \times 10^{-6} \text{ or } 6 \times 10^{-6}$$

Thus a 25 ppm cleanup level in soils is associated with an excess cancer risk of 6×10^{-6} and a noncancer hazard of 0.4.

4. Commercial/Industrial Subsurface (1-6 foot depth) - 200 ppm

The cleanup level for the 1-6 foot depth interval on commercial/industrial properties is 200 ppm. Based on the EREs and other Consent Decree provisions, it is expected that the only individual likely to be exposed to PCBs at 200 ppm in the 1-6 foot depth interval would be a utility worker conducting infrequent, short-term work in existing utility corridors (e.g., emergency utility repairs).

This cleanup level is deemed protective for such situations. In estimating cancer and noncancer risks associated with this cleanup level, it is assumed that the worker is exposed during these situations to contaminated subsurface soil for 5 days per year for 25 years. This exposure is evaluated cumulatively over 25 years, not as separate acute exposures. Dermal contact with and incidental ingestion of soil was considered. It was assumed that the worker's head, hands and forearms could come into contact with contaminated soil.

The cleanup level of 200 ppm equates to a Hazard Index of 0.9 and an excess cancer risk of 1×10^{-5}.

The values used to calculate the risk levels associated with 200 ppm are provided below. Sources for each value are also provided. The equations used are the same as those used to estimate risks for Industrial areas and are shown in Section 3.

Values used to estimate risks associated with the cleanup level of 200 ppm

HQ	=	Hazard Quotient
ELCR	=	Excess Lifetime Cancer Risk
IR	=	Soil Ingestion Rate, 137 mg/kg (ChemRisk, 1997)
F	=	Exposure Frequency, 5 days/yr (Geraghty and Miller, 1992)
D	=	Exposure Duration, 25 yrs; Site specific
C_s	=	Concentration in soil (cleanup level), 200 mg/kg
BW	=	Body weight, 70 kg (EPA 1991)
At_{nc}	=	Averaging Time for noncancer, 9125 days (25 years x 365 days/yr)
At_c	=	Averaging Time for cancer, 25550 days (70 yrs x 365 days/yr)
SA	=	Skin surface area, 3300 cm^2, (head, hands, forearms) (EPA 1997)
AF	=	Adherence Factor, 0.8 mg/cm^2-day, The AF dataset for a utility worker was chosen because it represents a "typical" or central tendency activity for a utility worker. The 95^{th} % AF of this dataset best approximates an RME scenario, (Kissel *et al.*, in press; EPA 1998)
ABS_d	=	dermal absorption factor, 0.14 for PCBs (Wester *et al.*, 1993)
ABS_o	=	GI absorption factor, 1 for PCBs (from PTI, 1993)
RfD	=	Reference Dose, 2 x 10^{-5} mg/kg/day (IRIS 1996)
CSF	=	Cancer slope factor for PCBs, 2 $(mg/kg\text{-}day)^{-1}$ (IRIS 1998)
C	=	Conversion, 10^{-6} kg/mg

Substituting the above values into the equation for estimating noncancer risks:

$$HQ = \frac{200x5x25}{70x9125}\left[\frac{(1)}{2 \times 10^{-5}} \times \frac{(137x\ 1x1)}{10^{6}}\right] + \left[\frac{(1)}{2 \times 10^{-5}} \times \frac{(3300 \times 0.8x\ 0.14)}{10^{6}}\right]$$

$$HQ = \frac{25000\ [137/20 + 369/20]}{638750} = 0.9$$

Substituting the above values into the equation for estimating cancer risks:

$$ELCR = \frac{200x5x25x2\ [(1x137x\ 1) + (3300x\ 0.8x\ 0.14)]}{70x25550x\ 10^{6}}$$

$$ELCR = \frac{50000\ [137+369]}{1788500x\ 10^{6}} = 1.4x\ 10^{-5}$$

5. Current and Future Residential Property (0-15 foot depth)- 2 ppm

A cleanup level of 2 ppm must be met in residential areas. The 2 ppm concentration is the MA DEP's generic Method 1 soil cleanup standard for residential use. We have relied on the Method 1 standard in determining the cleanup level. However, below we have also presented risk calculation to provide quantitative risk measurements. This level is protective for young children and adults who may be exposed to contaminated soil while playing in their yard or while gardening or doing yard work. In evaluating risks associated with this cleanup level, it was assumed that residents are exposed to contaminated soil in their yard 5 days per week for 7 months of the year (May through November) when the ground is not frozen or snow-covered. Noncancer risks were evaluated for a young child aged 1-6. Cancer risks were evaluated for a resident aged 1-30 years. It was assumed that a child resident's head, lower arms, hands, lower legs and feet could be exposed to contaminated soil from May through September and that an adult resident's head, lower arms, hands and lower legs would be exposed. In October and November, both a child and adult resident's hands and face could be exposed. Dermal contact with soil and incidental ingestion of soil were considered.

The values used to calculate the risks are provided below.

Estimated noncancer hazard associated with oral and dermal exposure to recreational soils

$$HQ = C_s x F x D \left[\left(\frac{1}{(BW_C x AT_{nc}) RfD_o} x \frac{IR_c x FI x ABS_o}{10^6 mg/kg}\right) + \left(\frac{1}{RfD_o} x \frac{[((AF_1 x SA_1 x 5)+(SA_2 x AF_2 x 2))/7] x ABS_d}{10^6 mg/kg}\right)\right]$$

HQ = hazard quotient
C_s = PCB concentration in soil, (i.e., cleanup level) (2mg/kg)
F = exposure frequency; (150dys/yr)=5dys/wk for 7mos/yr, (May-Nov); site-specific
D = duration;(child - 6 yrs); Site-specific
IR_c= soil ingestion rate for child 1-6; 200mg/dy; EPA, 1991
FI = fraction ingested from site; (1); site-specific
ABS_o= GI absorption fraction; (1); PTI, 1993
SA_1 = surface area of a child exposed during May thru Sept = head, hands, lower arms, lower legs and feet; for child 1-6 =2900 cm^2 ;EPA, 1997; Based on same information for noncancer calculations for a recreational child (see above).
AF_1 = overall skin adherence factor weighted by body-part exposed;
For child 1-6 = 0.24mg/cm^2 -event: See calculations for recreational child above.
SA_2= surface area for a child exposed during Oct thru Nov. = head and hands;
= 1340 cm^2 for 1-6 yr old
AF_2= overall skin adherence factor weighted by body part exposed from Oct thru Nov; 0.23mg/cm^2 (see calculation for a recreational child)
ABS_d = dermal absorption fraction; (0.14), Wester et. al, 1993
BW = average body weight; 15 for 1-6yr old (EPA, 1997)
AT_{nc} = averaging time, 6yrsx365dys/yr - (2190 dys); Site-specific
RfD = reference dose for Aroclor 1254 = $2x10^{-5}$ mg/kg-dy; IRIS, 1998
Substituting the values above into the equation:

$$THQ = \frac{2x 150 x6}{[15x2190]} \left[\left(\frac{1}{2x10^{-5}} \frac{x200 x 1}{10^6}\right) + \left(\frac{1}{2x 10^{-5}} x \frac{[((2900x 0.24 x 5) +(1340 x0.23 x 2))/7]x 0.14}{10^6}\right)\right]$$

$$= \frac{1800}{(32850)}\left(\frac{200}{20} + \frac{81.9}{20}\right) = 0.055x 14= 0.77 \text{ or } 0.8$$

Estimated excess cancer risk associated with oral and dermal exposure to residential soils

$$ELCR = \frac{C_s \times F\,[(CSF \times ABS_o \times IF_{adj}) + (SFS_{adj} \times CSF \times ABS_d)]}{AT_c \times 10^6\ mg/kg}$$

Where;.

ELCR = excess lifetime cancer risk

C_s = PCB concentration in soil, (i.e., cleanup level) (2mg/kg)

F = exposure frequency; (150dys/yr)=5dys/w for 7mos/yr, (May-Nov); site-specific

CSF = cancer slope factor for PCBs (2 mg/kg-dy)$^{-1}$; IRIS, 1998

ABS_o = GI absorption fraction; (1); PTI, 1993

IF_{adj} = age- adjusted soil ingestion factor, equal to:

$$\frac{(FI)(IR_{1\text{-}6})(D_{1\text{-}6})}{BW_{1\text{-}6}} + \frac{(FI)(IR_{7\text{-}31})(D_{7\text{-}31})}{BW_{7\text{-}31}} = 80 + 34.28 = 114\text{mg-yr/kg-dy}$$

Where;

IR_c = soil ingestion rate; child 1-6; 200mg/dy; child 7-31; 100mg/dy; EPA, 1991

FI = fraction ingested from site; (1); site-specific

BW = average body weight; 15 for 1-6yr old; 70 for 7-31 yr old; EPA, 1997,

D = duration;1-6yrs old -6 yrs; 7-31 yr old - 24yr; Site-specific

SFS_{adj} = age-adjusted soil contact factor=

$$\frac{(D_{1\text{-}6})[((AF_1 \times SA_1 \times 5)+(SA_2 \times AF_2 \times 2))/7]_{1\text{-}6}}{BW_{1\text{-}6}} + \frac{(D_{7\text{-}31})[((AF_1 \times SA_1 \times 5)+(SA_2 \times AF_2 \times 2))/7]_{7\text{-}31}}{BW_{7\text{-}31}}$$

$$= \frac{(6)[((0.24 \times 2900 \times 5)+(0.23 \times 1340 \times 2))/7]}{15} + \frac{(24)[((0.1 \times 5700 \times 5)+(0.15 \times 2110 \times 2))/7]}{70} =$$

$$= \frac{6[(3480+616.4)/7]}{15} + \frac{24[(2850+633)/7]}{70} = 234.1+170.6 = 404.7$$

Where;

SA_1 = surface area of a child exposed during May thru Sept = head, hands, lower arms, lower legs and feet; for child 1-6 =2900 cm^2 (see above), for 7-31=5700 cm^2;EPA, 1997; Same assumptions and approach as in recreational calculations.

AF_1 = overall skin adherence factor weighted by body-part exposed;

For child 1-6 = 0.24mg/cm^2 -event(see recreational scenario above);

For 7-31:= 0.1mg/cm^2-event Based on:

- used Kissel data listed in EPA, 1997 for gardeners. Used 50th percentile AFs which result in overall 50th percentile AF. Surface area based on 7-31 yr old

AF_2 = overall skin adherence factor weighted by body-part exposed; hands and face exposed

For child 1-6 = 0.23mg/cm^2 (see recreational scenario above)

$$AF_{2\,(7\text{-}31)} = \frac{(402)(0.053)+(904)(0.19)}{402+904} = 0.15\text{mg/cm}^2$$

SA_2= surface area for a child exposed during Oct thru Nov. = head and hands;

1340 cm^2 for 1-6 yr old; 2110 cm ^{2} for 7-31 yr old

ABS_d = dermal absorption fraction; (0.14), Wester et. al, 1993
ABS_d = dermal absorption fraction; (0.14),Wester et. al, 1993
AT_c = averaging time, 70yrsx365dys/yr - (25550days); Site specific

Substituting the values above into the equation:

$$ELCR = \frac{2x150\ [(2x1x114) + (404.7x0.14\ x2)]}{(25550)(10^6 mg/kg)}$$

$$= \frac{300(228 + 113.3)}{25550x10^6} = \frac{102394.8}{25550x\ 10^6} = 4.0 \times 10^{-6}$$

The cleanup level of 2 ppm equates to a Hazard Quotient of 0.8 and an excess cancer risk of $4x10^{-6}$.

6. Allendale School (0-15 feet) 2 ppm

A cleanup level of 2 ppm has been chosen for Allendale School. This is the generic MCP Method 1 standard for PCB at residential properties. The assumptions and calculation would mirror those assumptions and calculations for the residential properties presented above. This cleanup level is also protective of the current use of this area (i.e. as a playground and sports field).

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APPENDIX Q.8

ECOLOGICAL RISK GOALS FOR THE EE/CA FOR THE EAST BRANCH HOUSATONIC RIVER (EPA MEMORANDUM DATED 7 FEBRUARY 2000)

MEMORANDUM

DATE: February 7, 2000

SUBJECT: Ecological Risk Goals for the EE/CA for the East Branch Housatonic River

FROM: Susan C. Svirsky Susan C. Svirsky

TO: Chet Janowski

This memorandum summarizes the ecological risk-based goals to be used in the Engineering Evaluation/Cost Evaluation (EE/CA) for the 1 ½ mile reach of the East Branch of the Housatonic River. Goals need to be established for remediation of both river sediments and bank soils that are protective of ecological receptors. The goal for the river sediments is to protect aquatic life and piscivorous mammals and birds. The goal for the bank soils is to protect terrestrial mammals and birds. These goals are based upon the information and conclusions summarized in the "*Upper Reach - Housatonic River Ecological Risk Assessment*" (ERA)(Weston, 1998), and subsequent sediment and river bank data that have been collected for the purpose of the EE/CA.

BACKGROUND

It has been documented extensively in the literature that polychlorinated biphenyls (PCBs) in the ecosystem cause a variety of adverse effects to ecological receptors, including death, birth defects, reproductive failure impairment, liver damage, tumors, behavioral modifications, and a "wasting"syndrome (Eisler, 1996), and that some forms of PCBs (congeners) are believed to result in endocrine disruption in ecological receptors. PCBs bioaccumulate and biomagnify, primarily due to the affinity PCBs have for fatty tissue. This ability to biomagnify means that the concentrations of PCBs in the organisms at the bottom of food chain have a profound effect on entire food chain.

Studies documented in the literature demonstrate that different animals (for example, fish vs. mammals) have greatly differing sensitivities and resulting effects from exposure to PCBs. Even difference species within a group (such as river otter vs. mink) may have varying sensitivities to PCBs.

For this reason, the ecological risk-based goals for the EE/CA are derived to be protective for the more sensitive receptors, and in doing so are deemed to be protective of the entire ecosystem.

RIVER SEDIMENTS

The most sensitive pathway for ecological exposure to PCB contamination in the river is through the aquatic food chain. One measure of this exposure is the EPA draft Sediment Quality Guidelines (SQG) approach, which is based upon the equilibrium partitioning theory using the chronic Ambient Water Quality Criteria (AWQC). For PCBs, the chronic AWQC was derived for the protection of mink consuming fish. Additional measures of aquatic effects are documented by the numerous other sediment quality benchmarks for PCBs which have been established to provide the scientific and regulatory communities with tools to evaluate the severity of sediment contamination. Some of the benchmarks use adverse effects to the benthic community as endpoint, while others indirectly use food chain transfers the endpoint.

A summary of the SQG and existing applicable benchmarks for PCBs is outlined in Table 1. Table 2 provides comparison of these benchmarks against existing sediment and total organic carbon data collected from the EECA reach expressed as Hazard Quotients, that is the amount by which the guideline is exceeded.

This comparison results in a qualitative evaluation which identifies whether potential impacts to the benthic community and piscivorous receptors are possible or probable based upon the concentration of PCBs present in sediments. The concentrations of PCBs in river sediments that result in adverse effects to a number of different ecological endpoints (including benthic invertebrates, fish, and birds and mammals which rely upon fish for large portion of their diet), range from 0.0227 mg/kg to 5.72 mg/kg at approximately 1% organic carbon. The lower values are thought to be conservative, either influenced to some degree by other, co-occurring contaminants or representing a theoretical exposure based upon equilibrium partitioning. While there is uncertainty surrounding the protectiveness of a level of 1 mg/kg, it is not representative of worst-case assumptions nor is it a no adverse effect level. In addition, the benchmark values were based upon data sets that generally reviewed total PCB data and may not be reflective of the more highly chlorinated PCB mixtures (primarily Aroclor 1260) that are found at the site.

RIVER BANK SOILS

The critical ecological receptors of concern from exposure to PCB contaminated river bank soils include small mammals such as shrews and moles that typically have smaller foraging areas (e.g. as small as one-fifth an acre), and other larger mammals that burrow and den in and on the banks. In this reach, numerous species of large burrowing and den-building mammals have been noted, including beaver, muskrat, woodchuck, fox, racoon, and skunk.

PCB cleanup concentrations were derived for the protection of human health exposure to river bank soils in the EE/CA reach. Two scenarios are being applied, a residential exposure and a recreational exposure. The resultant PCB cleanup concentrations are 2 mg/kg, and 10 mg/kg in the top 3 feet minimum, respectively. These cleanup numbers and the application of these numbers in the EE/CA was evaluated to determine the protectiveness of these actions for ecological receptors.

All residential properties will be remediated to a 2 mg/kg 95% UCL concentration of PCBs in river bank soils. Most of the residential property river banks contain habitat likely to support a number of ecological receptors, including the more affected species described above. The cleanup of the river banks on these properties to 2 mg/kg 95% UCL will be adequate to eliminate risk to ecological receptors with unlimited exposure and under any scenario. This will also be protective, with the restoration of the banks with clean materials, for the potential of erosion of river bank soil into the river.

Properties determined to have recreational rather than residential use in this reach are so designated due to the very steep nature of the banks. These properties will have the top 3 feet of river bank soil removed and replaced with clean soil to achieve 10 mg/kg 95% UCL. This cleanup as proposed in the EE/CA is also expected to be fully protective for ecological receptors including those deep burrowing species without additional precautions for risk reduction. While a site-specific cleanup goal has not been calculated for this reach, the assessment performed in the ERA for exposure of receptors in the river banks, the degraded, urbanized habitat present in this reach, and calculations of cleanup goals performed for the exposure of these or similar receptors to PCBs at other sites support this finding. In addition, restoration of the banks with clean material will further reduce the potential for erosion of highly contaminated river bank soil into the river resulting in recontamination of river sediments.

Table 1

Sediment Quality Guidelines for Polychlorinated Biphenyls
Upper Reach – Housatonic River
Pittsfield, Massachusetts

Guideline	Total PCBs
NOAA Standards [a] ***(mg/kg DW)***	
Effects Range – Low (ER-L)	0.0227
Effects Range – Median (ER-M)	0.18
Ontario Standards [b] ***(mg/kg DW)***	
Lowest Effect Level (LEL)	0.07
Severe Effect Level (SEL)	5.72[c]
EPA SQG [d] ***(mg/kg DW)***	
SQG	0.0818

[a] Long et al., 1995.
[b] Persaud et al., 1996.
[c] The bulk sediment SEL is derived by multiplying the sample-specific fraction organic carbon (FOC) (to a maximum of 0.1) by 530 mg PCB/kg OC. The FOC is equivalent to the total organic carbon (TOC) in units of % divided by 100.The bulk sediment SEL presented in this table was calculated using an average site-specific FOC of 0.0108 (i.e., 1.08%). (Average FOC calculated with non-detects included at 1/2 the SQL.)
[d] U.S. EPA, 1993a. The SQG was calculated as a bulk sediment value (i.e., in mg/kg DW) using the equation below. Note that mg/kg is equivalent to µg/g.

SQG (mg/kg DW) = K_{oc} * FOC * CF * FCV
where: K_{oc} = 5.41E+05 L/kg, based on Aroclor 1254 (Mackay et al., 1992).
FOC = 0.0108, average site-specific value.
CF = 1E-03 kg/g.
FCV = 0.014 µg/L (Federal AWQC for Aroclor 1254).

Table 2

Comparison of Total PCB Concentrations to Sediment Guidelines

Location ID	Total Organic Carbon (mg/kg)	Total PCBs (mg/kg)	Hazard Quotient				
			NOTE: Hazard quotients represent the degree of exceedance				
			NOAA[a]		OMEE[b]		
			Effects Range-Low (ER-L)[c]	Effects Range-Median (ER-M)[d]	Lowest Effect Level (LEL)[e]	Severe Effect Level (SEL)[f]	SQG[g]
Lyman Street to Elm Street							
SE000007	1.34E+03	3.60E+00	1.59E+02	2.00E+01	5.14E+01	5.07E+00	3.53E+02
SD010661	3.94E+03 J	5.49E+00	2.42E+02	3.05E+01	7.84E+01	2.63E+00	1.83E+02
SD010662	2.10E+04 J	1.72E+01	7.58E+02	9.56E+01	2.46E+02	1.55E+00	1.08E+02
SD010681	3.28E+03 J	5.50E+01	2.42E+03	3.06E+02	7.86E+02	3.16E+01	2.21E+03
SD010682	5.30E+03 J	1.25E+00	5.51E+01	6.94E+00	1.79E+01	4.45E-01	3.10E+01
SD010683	3.09E+03 J	1.35E+00	5.95E+01	7.50E+00	1.93E+01	8.24E-01	5.75E+01
SD010701	1.66E+03 UJ	9.02E+01	3.97E+03	5.01E+02	1.29E+03	1.02E+02	7.15E+03
SD010702	2.66E+03 J	2.75E-01 *	1.21E+01	1.53E+00	3.92E+00	1.95E-01	1.36E+01
SD010703	3.06E+03 J	1.87E+00	8.24E+01	1.04E+01	2.67E+01	1.15E+00	8.04E+01
SD010721	2.07E+03 J	1.39E+01	6.12E+02	7.72E+01	1.99E+02	1.27E+01	8.84E+02
SD010722	9.27E+03 J	4.54E+00	2.00E+02	2.52E+01	6.49E+01	9.24E-01	6.44E+01
SD010723	4.90E+03 J	3.39E+00	1.49E+02	1.88E+01	4.84E+01	1.31E+00	9.10E+01
SD010741	NA	1.04E+00	4.58E+01	5.78E+00	1.49E+01	NA	NA
SD010742	NA	3.17E-01 *	1.39E+01	1.76E+00	4.52E+00	NA	NA
SD010743	NA	2.27E+00	1.00E+02	1.26E+01	3.24E+01	NA	NA
SD010761	NA	1.35E+00	5.95E+01	7.50E+00	1.93E+01	NA	NA
SD010761	NA	4.16E+00	1.83E+02	2.31E+01	5.94E+01	NA	NA
SD010762	NA	1.94E+01	8.55E+02	1.08E+02	2.77E+02	NA	NA
SD010763	NA	1.18E+01	5.20E+02	6.56E+01	1.69E+02	NA	NA
SD010781	NA	3.27E+00	1.44E+02	1.82E+01	4.67E+01	NA	NA
SD010782	NA	6.19E+00	2.73E+02	3.44E+01	8.84E+01	NA	NA
SD010783	NA	5.84E+00	2.57E+02	3.24E+01	8.34E+01	NA	NA
SD010801	NA	3.30E+00	1.45E+02	1.83E+01	4.71E+01	NA	NA
SD010801	NA	2.85E+01	1.26E+03	1.58E+02	4.07E+02	NA	NA
SD010802	NA	1.48E+00	6.52E+01	8.22E+00	2.11E+01	NA	NA
SD010803	NA	6.04E+00	2.66E+02	3.36E+01	8.63E+01	NA	NA
SD010821	NA	3.98E-01 *	1.75E+01	2.21E+00	5.69E+00	NA	NA
SD010822	NA	3.31E+00	1.46E+02	1.84E+01	4.73E+01	NA	NA
SD010823	NA	1.40E+00	6.17E+01	7.78E+00	2.00E+01	NA	NA
SD010841	NA	4.57E+00	2.01E+02	2.54E+01	6.53E+01	NA	NA
SD010841	NA	2.90E+00	1.28E+02	1.61E+01	4.14E+01	NA	NA
SD010842	NA	5.47E-01	2.41E+01	3.04E+00	7.81E+00	NA	NA
SD010843	NA	7.21E-01	3.18E+01	4.01E+00	1.03E+01	NA	NA
SD010861	NA	6.54E+00	2.88E+02	3.63E+01	9.34E+01	NA	NA
SD010862	NA	4.01E+00	1.77E+02	2.23E+01	5.73E+01	NA	NA
SD010863	NA	5.34E+00	2.35E+02	2.97E+01	7.63E+01	NA	NA
SD010881	NA	2.73E+01	1.20E+03	1.52E+02	3.90E+02	NA	NA
SD010881	NA	2.27E+01	1.00E+03	1.26E+02	3.24E+02	NA	NA
SD010882	NA	3.01E-01 *	1.33E+01	1.67E+00	4.30E+00	NA	NA

Table 2

Comparison of Total PCB Concentrations to Sediment Guidelines

Location ID	Total Organic Carbon (mg/kg)	Total PCBs (mg/kg)	Hazard Quotient — NOTE: Hazard quotients represent the degree of exceedance — NOAA[a] Effects Range-Low (ER-L)[c]	NOAA[a] Effects Range-Median (ER-M)[d]	OMEE[b] Lowest Effect Level (LEL)[e]	OMEE[b] Severe Effect Level (SEL)[f]	SQG[g]
SD010883	NA	2.74E+00	1.21E+02	1.52E+01	3.91E+01	NA	NA
SD010901	9.57E+03	1.36E+00	5.99E+01	7.56E+00	1.94E+01	2.68E-01	1.87E+01
SD010902	1.09E+02 U	2.00E+01	8.81E+02	1.11E+02	2.86E+02	3.46E+02	2.41E+04
SD010903	1.74E+04	1.07E+01	4.71E+02	5.94E+01	1.53E+02	1.16E+00	8.09E+01
SD010921	6.95E+03	2.24E+00	9.87E+01	1.24E+01	3.20E+01	6.08E-01	4.24E+01
SD010922	2.61E+03 U	4.58E-01	2.02E+01	2.54E+00	6.54E+00	3.31E-01	2.31E+01
SD010941	1.70E+04	1.97E+00	8.68E+01	1.09E+01	2.81E+01	2.19E-01	1.52E+01
SD010942	4.46E+03 U	2.96E+00	1.30E+02	1.64E+01	4.23E+01	1.25E+00	8.73E+01
SD010943	1.07E+02 U	1.19E+00	5.24E+01	6.61E+00	1.70E+01	2.10E+01	1.46E+03
SD010961	1.63E+04	2.84E+00	1.25E+02	1.58E+01	4.06E+01	3.29E-01	2.29E+01
SD010961	2.27E+04	1.48E+00	6.52E+01	8.22E+00	2.11E+01	1.23E-01	8.58E+00
SD010962	7.29E+03 U	8.33E-01	3.67E+01	4.63E+00	1.19E+01	2.16E-01	1.50E+01
SD010981	1.21E+04	1.72E+00	7.58E+01	9.56E+00	2.46E+01	2.68E-01	1.87E+01
SD010981	2.05E+04	1.42E+00	6.26E+01	7.89E+00	2.03E+01	1.31E-01	9.11E+00
SD011001	4.08E+03	6.17E+00	2.72E+02	3.43E+01	8.81E+01	2.85E+00	1.99E+02
SD011001	1.39E+04	4.93E+01	2.17E+03	2.74E+02	7.04E+02	6.69E+00	4.67E+02
SD011002	2.57E+04	1.21E+01	5.33E+02	6.72E+01	1.73E+02	8.88E-01	6.19E+01
SD011002	1.62E+04	4.01E-01 *	1.76E+01	2.23E+00	5.72E+00	4.66E-02	3.25E+00
SD011003	4.92E+04	1.79E+00	7.89E+01	9.94E+00	2.56E+01	6.86E-02	4.79E+00
SD011021	NA	1.07E+01	4.71E+02	5.94E+01	1.53E+02	NA	NA
SD011022	1.17E+04	3.80E+00	1.67E+02	2.11E+01	5.43E+01	6.13E-01	4.27E+01
SD011023	1.31E+04	5.87E+00	2.59E+02	3.26E+01	8.39E+01	8.45E-01	5.90E+01
SD011041	1.51E+04	2.79E+00	1.23E+02	1.55E+01	3.99E+01	3.49E-01	2.43E+01
SD011042	7.53E+02	3.49E+00	1.54E+02	1.94E+01	4.99E+01	8.74E+00	6.10E+02
SD011043	1.09E+03	3.99E+01	1.76E+03	2.22E+02	5.70E+02	6.91E+01	4.82E+03
SD021062	4.29E+03 U	9.09E-01	4.00E+01	5.05E+00	1.30E+01	4.00E-01	2.79E+01
SD021063	1.07E+04	1.97E+01	8.68E+02	1.09E+02	2.81E+02	3.47E+00	2.42E+02
Elm Street to Dawes Avenue							
SE000001	1.03E+04	3.53E-01 *	1.56E+01	1.96E+00	5.04E+00	6.47E-02	4.51E+00
SE000021	NA	4.15E-01 *	1.83E+01	2.31E+00	5.93E+00	NA	NA
SE000021	1.01E+03	9.70E+00	4.27E+02	5.39E+01	1.39E+02	1.81E+01	1.26E+03
SE000021	NA	5.10E+00	2.25E+02	2.83E+01	7.29E+01	NA	NA
SE000022	1.91E+04	2.20E-01	9.69E+00	1.22E+00	3.14E+00	2.17E-02	1.52E+00
SE000022	1.00E+02 U	1.80E+02	7.93E+03	1.00E+03	2.57E+03	3.40E+03	2.37E+05
SE000022	1.15E+04	1.90E+00	8.37E+01	1.06E+01	2.71E+01	3.12E-01	2.17E+01
SE000473	4.11E+04	1.11E+02	4.89E+03	6.17E+02	1.59E+03	5.10E+00	3.55E+02
SE000475	7.24E+05	1.03E+00 *	4.52E+01	5.69E+00	1.46E+01	1.93E-02	1.86E-01
SD021101	6.33E+03	2.60E+01	1.15E+03	1.44E+02	3.71E+02	7.75E+00	5.40E+02
SD021103	7.07E+03	3.06E+00	1.35E+02	1.70E+01	4.37E+01	8.17E-01	5.69E+01
SD021123	7.54E+04	1.00E-01	4.41E+00	5.56E-01	1.43E+00	2.50E-03	1.75E-01

Table 2

Comparison of Total PCB Concentrations to Sediment Guidelines

Location ID	Total Organic Carbon (mg/kg)	Total PCBs (mg/kg)	Hazard Quotient — NOTE: Hazard quotients represent the degree of exceedance — NOAA[a] Effects Range-Low (ER-L)[c]	NOAA[a] Effects Range-Median (ER-M)[d]	OMEE[b] Lowest Effect Level (LEL)[e]	OMEE[b] Severe Effect Level (SEL)[f]	SQG[g]
SD021202	5.63E+04	2.51E-01 *	1.10E+01	1.39E+00	3.58E+00	8.40E-03	5.85E-01
SD021203	2.90E+03	7.16E+00	3.15E+02	3.98E+01	1.02E+02	4.66E+00	3.25E+02
SD021223	1.27E+04	9.99E+01	4.40E+03	5.55E+02	1.43E+03	1.48E+01	1.04E+03
SD021262	3.19E+04	3.55E+01	1.56E+03	1.97E+02	5.07E+02	2.10E+00	1.46E+02
SD021281	4.66E+03 J	3.51E-01	1.55E+01	1.95E+00	5.01E+00	1.42E-01	9.91E+00
SD021282	3.73E+03	2.81E-01 *	1.24E+01	1.56E+00	4.01E+00	1.42E-01	9.91E+00
SD021283	5.69E+03	1.40E+00	6.17E+01	7.78E+00	2.00E+01	4.64E-01	3.24E+01
SD021302	5.23E+03	2.08E+00	9.16E+01	1.16E+01	2.97E+01	7.50E-01	5.23E+01
SD021362	3.28E+03	3.00E+00	1.32E+02	1.67E+01	4.29E+01	1.73E+00	1.20E+02
SD021401	1.21E+02 U	6.47E+00	2.85E+02	3.59E+01	9.24E+01	1.01E+02	7.04E+03
SD021403	3.59E+03	7.98E-01	3.52E+01	4.43E+00	1.14E+01	4.19E-01	2.92E+01
SD021403	3.22E+03 U	1.06E+00	4.67E+01	5.89E+00	1.51E+01	6.21E-01	4.33E+01
SD021442	1.68E+04	8.50E+00	3.74E+02	4.72E+01	1.21E+02	9.55E-01	6.66E+01
SD021501	1.18E+02 U	2.59E+00	1.14E+02	1.44E+01	3.70E+01	4.14E+01	2.89E+03
Dawes Avenue to Confluence							
SD021522	6.36E+03	3.08E+00	1.36E+02	1.71E+01	4.40E+01	9.14E-01	6.37E+01
SD021523	1.21E+02 U	2.68E+00	1.18E+02	1.49E+01	3.83E+01	4.18E+01	2.91E+03
SD021541	6.22E+03	4.20E+00	1.85E+02	2.33E+01	6.00E+01	1.27E+00	8.88E+01
SD021542	9.15E+02	4.50E+01	1.98E+03	2.50E+02	6.43E+02	9.28E+01	6.47E+03
SD021542	2.99E+04	3.80E+00	1.67E+02	2.11E+01	5.43E+01	2.40E-01	1.67E+01
SD021543	8.13E+03	9.29E+00	4.09E+02	5.16E+01	1.33E+02	2.16E+00	1.50E+02
SD021561	1.38E+02 U	2.14E+01	9.43E+02	1.19E+02	3.06E+02	2.93E+02	2.04E+04
SD021562	1.39E+04	5.64E+00	2.48E+02	3.13E+01	8.06E+01	7.66E-01	5.34E+01
SD021562	1.85E+03	5.37E+00	2.37E+02	2.98E+01	7.67E+01	5.48E+00	3.82E+02
SD021581	5.93E+03 U	1.68E+00	7.40E+01	9.33E+00	2.40E+01	5.35E-01	3.73E+01
SD021581	5.84E+03 U	3.42E+00	1.51E+02	1.90E+01	4.89E+01	1.10E+00	7.71E+01
SD021582	2.70E+02	1.00E+02	4.41E+03	5.56E+02	1.43E+03	6.99E+02	4.87E+04
SD021583	2.64E+03 U	2.72E-01 *	1.20E+01	1.51E+00	3.89E+00	1.94E-01	1.36E+01
SD021601	2.34E+04	5.66E+00	2.49E+02	3.14E+01	8.09E+01	4.56E-01	3.18E+01
SD021602	5.17E+03 U	3.43E+01	1.51E+03	1.91E+02	4.90E+02	1.25E+01	8.73E+02
SD021603	2.71E+03 U	2.13E+01	9.38E+02	1.18E+02	3.04E+02	1.48E+01	1.03E+03
SD021621	1.42E+03	1.50E+01	6.61E+02	8.33E+01	2.14E+02	1.99E+01	1.39E+03
SD021622	2.96E+03 U	2.67E-01 *	1.17E+01	1.48E+00	3.81E+00	1.70E-01	1.18E+01
SD021623	1.14E+02 U	3.10E+02	1.37E+04	1.72E+03	4.43E+03	5.13E+03	3.58E+05
SD021623	1.14E+02 U	2.81E-01 *	1.24E+01	1.56E+00	4.01E+00	4.65E+00	3.24E+02
SD021642	3.17E+02	5.10E+01	2.25E+03	2.83E+02	7.29E+02	3.04E+02	2.12E+04
SD021643	7.10E+02	9.36E+00	4.12E+02	5.20E+01	1.34E+02	2.49E+01	1.73E+03
SD021661	1.17E+02 U	1.38E+00	6.08E+01	7.67E+00	1.97E+01	2.23E+01	1.55E+03
SD021662	1.13E+02 U	7.36E+00	3.24E+02	4.09E+01	1.05E+02	1.23E+02	8.57E+03
SD021663	1.12E+02 U	2.49E+00	1.10E+02	1.38E+01	3.56E+01	4.19E+01	2.93E+03

Table 2

Comparison of Total PCB Concentrations to Sediment Guidelines

Location ID	Total Organic Carbon (mg/kg)	Total PCBs (mg/kg)	Hazard Quotient — NOTE: Hazard quotients represent the degree of exceedance — NOAA[a]: Effects Range-Low (ER-L)[c]	NOAA[a]: Effects Range-Median (ER-M)[d]	OMEE[b]: Lowest Effect Level (LEL)[e]	OMEE[b]: Severe Effect Level (SEL)[f]	SQG[g]
SD021681	2.74E+03	5.10E+00	2.25E+02	2.83E+01	7.29E+01	3.51E+00	2.45E+02
SD021681	2.39E+02	8.93E+00	3.93E+02	4.96E+01	1.28E+02	7.05E+01	4.92E+03
SD021682	9.55E+02	5.41E+00	2.38E+02	3.01E+01	7.73E+01	1.07E+01	7.45E+02
SD021683	1.14E+02 U	2.28E+00	1.00E+02	1.27E+01	3.26E+01	3.77E+01	2.63E+03
SD021701	7.83E+02	8.20E+01	3.61E+03	4.56E+02	1.17E+03	1.98E+02	1.38E+04
SD021702	4.27E+03 U	6.44E-01	2.84E+01	3.58E+00	9.20E+00	2.85E-01	1.98E+01
SD021703	4.85E+03 U	2.34E+00	1.03E+02	1.30E+01	3.34E+01	9.10E-01	6.35E+01
SD021721	4.54E+03 U	2.98E-01 *	1.31E+01	1.66E+00	4.26E+00	1.24E-01	8.64E+00
SD021722	4.33E+03 U	3.02E-01	1.33E+01	1.68E+00	4.31E+00	1.32E-01	9.18E+00
SD021723	4.36E+03 U	2.72E-01 *	1.20E+01	1.51E+00	3.89E+00	1.18E-01	8.21E+00
SD021741	4.38E+03 U	3.23E+00	1.42E+02	1.79E+01	4.61E+01	1.39E+00	9.70E+01
SD021742	1.24E+02 U	1.20E+00	5.29E+01	6.67E+00	1.71E+01	1.83E+01	1.27E+03
SD021742	1.26E+02 U	3.03E-01 *	1.33E+01	1.68E+00	4.32E+00	4.53E+00	3.16E+02
SD021761	4.46E+03 U	1.28E+01	5.64E+02	7.11E+01	1.83E+02	5.42E+00	3.78E+02
SD021762	4.85E+03 U	3.01E-01 *	1.33E+01	1.67E+00	4.30E+00	1.17E-01	8.17E+00
SD021763	5.58E+03	1.05E+00	4.63E+01	5.83E+00	1.50E+01	3.55E-01	2.48E+01
SD021781	4.62E+03 U	2.84E-01 *	1.25E+01	1.58E+00	4.06E+00	1.16E-01	8.09E+00
SD021782	4.31E+03 U	2.10E+01	9.25E+02	1.17E+02	3.00E+02	9.19E+00	6.41E+02
SD021782	NA	6.97E-01	3.07E+01	3.87E+00	9.96E+00	NA	NA
SD021783	4.32E+03 U	2.71E-01 *	1.19E+01	1.51E+00	3.87E+00	1.18E-01	8.25E+00
SD021801	4.54E+03 U	1.16E+00	5.11E+01	6.44E+00	1.66E+01	4.82E-01	3.36E+01
SD021802	7.61E+03	1.16E+00	5.11E+01	6.44E+00	1.66E+01	2.88E-01	2.01E+01
SD021803	7.17E+03	1.10E+00	4.85E+01	6.11E+00	1.57E+01	2.89E-01	2.02E+01
SD021821	5.06E+03 U	3.78E+00	1.67E+02	2.10E+01	5.40E+01	1.41E+00	9.83E+01
SD021821	NA	9.90E+00	4.36E+02	5.50E+01	1.41E+02	NA	NA
SD021822	4.29E+03 U	1.51E+01	6.65E+02	8.39E+01	2.16E+02	6.64E+00	4.63E+02
SD021822	4.27E+03 U	5.96E+01	2.63E+03	3.31E+02	8.51E+02	2.63E+01	1.84E+03
SD021823	4.59E+03 U	2.84E-01 *	1.25E+01	1.58E+00	4.05E+00	1.17E-01	8.13E+00
SD021841	4.80E+03 U	2.95E-01 *	1.30E+01	1.64E+00	4.21E+00	1.16E-01	8.09E+00
SD021842	4.36E+03 U	2.73E-01 *	1.20E+01	1.51E+00	3.89E+00	1.18E-01	8.22E+00
SD021843	1.19E+03	1.50E+00	6.61E+01	8.33E+00	2.14E+01	2.38E+00	1.66E+02
SD021861	2.84E+03	2.70E-01 *	1.19E+01	1.50E+00	3.85E+00	1.79E-01	1.25E+01
SD021862	4.50E+03 U	2.66E-01 *	1.17E+01	1.48E+00	3.80E+00	1.12E-01	7.78E+00
SD021863	1.02E+04	9.46E+00	4.17E+02	5.26E+01	1.35E+02	1.75E+00	1.22E+02
SD021881	4.78E+03 U	3.04E-01 *	1.34E+01	1.69E+00	4.34E+00	1.20E-01	8.35E+00
SD021881	4.73E+03 U	4.77E+01	2.10E+03	2.65E+02	6.81E+02	1.90E+01	1.33E+03
SD021882	3.65E+03	1.23E+01	5.42E+02	6.83E+01	1.76E+02	6.36E+00	4.43E+02
SD021883	2.06E+03	2.68E-01 *	1.18E+01	1.49E+00	3.82E+00	2.45E-01	1.71E+01
SD021901	5.01E+03	1.06E+00	4.67E+01	5.89E+00	1.51E+01	3.99E-01	2.78E+01
SD021902	3.08E+03	1.45E+00	6.39E+01	8.06E+00	2.07E+01	8.88E-01	6.19E+01

Table 2

Comparison of Total PCB Concentrations to Sediment Guidelines

					Hazard Quotient				
					NOTE: Hazard quotients represent the degree of exceedance				
					NOAA[a]		OMEE[b]		
Location ID	Total Organic Carbon (mg/kg)		Total PCBs (mg/kg)		Effects Range-Low (ER-L)[c]	Effects Range-Median (ER-M)[d]	Lowest Effect Level (LEL)[e]	Severe Effect Level (SEL)[f]	SQG[g]
SD021903	7.07E+02		4.65E+01		2.05E+03	2.58E+02	6.64E+02	1.24E+02	8.65E+03
SD021921	2.15E+03		5.02E+00		2.21E+02	2.79E+01	7.17E+01	4.41E+00	3.07E+02
SD021922	4.30E+03	U	7.41E-01		3.26E+01	4.12E+00	1.06E+01	3.25E-01	2.27E+01
SD021923	1.18E+03		4.46E+00		1.96E+02	2.48E+01	6.37E+01	7.13E+00	4.97E+02
SD021941	3.77E+03		4.53E+00		2.00E+02	2.52E+01	6.47E+01	2.27E+00	1.58E+02
SD021942	1.19E+04		6.89E+00		3.04E+02	3.83E+01	9.84E+01	1.09E+00	7.62E+01
SD021943	9.85E+02		2.87E-01	*	1.26E+01	1.59E+00	4.09E+00	5.49E-01	3.83E+01
SD021961	4.49E+03	U	2.48E+00		1.09E+02	1.38E+01	3.54E+01	1.04E+00	7.27E+01
SD021961	NA		2.40E+01		1.06E+03	1.33E+02	3.43E+02	NA	NA
SD021962	1.59E+03		2.77E-01	*	1.22E+01	1.54E+00	3.95E+00	3.28E-01	2.29E+01
SD021963	8.70E+02		2.98E-01	*	1.31E+01	1.66E+00	4.26E+00	6.46E-01	4.51E+01
SD021981	1.89E+03		1.48E+01		6.52E+02	8.22E+01	2.11E+02	1.48E+01	1.03E+03
SD021982	1.09E+02	U	3.35E+01		1.48E+03	1.86E+02	4.79E+02	5.80E+02	4.04E+04
SD021983	1.17E+02	U	9.35E-01		4.12E+01	5.19E+00	1.34E+01	1.51E+01	1.05E+03
SD022001	1.13E+04		7.62E+00		3.36E+02	4.23E+01	1.09E+02	1.27E+00	8.87E+01
SD022002	1.12E+02	U	2.79E-01	*	1.23E+01	1.55E+00	3.99E+00	4.70E+00	3.28E+02
SD022003	4.41E+03	U	4.63E+01		2.04E+03	2.57E+02	6.61E+02	1.98E+01	1.38E+03
SD022021	4.46E+03	U	6.05E-01		2.67E+01	3.36E+00	8.64E+00	2.56E-01	1.78E+01
SD022022	4.58E+03	U	2.95E+00		1.30E+02	1.64E+01	4.21E+01	1.22E+00	8.48E+01
SD022023	4.61E+03	U	2.95E-01	*	1.30E+01	1.64E+00	4.21E+00	1.21E-01	8.41E+00
SD022041	1.10E+02	U	6.60E-01		2.91E+01	3.67E+00	9.43E+00	1.13E+01	7.89E+02
SD022042	4.37E+03	U	2.71E-01	*	1.19E+01	1.51E+00	3.87E+00	1.17E-01	8.16E+00
SD022043	4.56E+03	U	1.63E+01		7.18E+02	9.06E+01	2.33E+02	6.74E+00	4.70E+02
SD022061	4.25E+03	U	2.54E+00		1.12E+02	1.41E+01	3.63E+01	1.13E+00	7.86E+01
SD022061	1.21E+04		1.87E+02		8.24E+03	1.04E+03	2.67E+03	2.92E+01	2.03E+03
SD022062	4.43E+03	U	2.80E-01	*	1.23E+01	1.56E+00	4.00E+00	1.19E-01	8.32E+00
SD022063	4.63E+03	U	3.00E-01	*	1.32E+01	1.67E+00	4.29E+00	1.22E-01	8.53E+00
SD022063	NA		5.00E+01		2.20E+03	2.78E+02	7.14E+02	NA	NA
SD022081	4.83E+03	U	4.74E-01		2.09E+01	2.63E+00	6.77E+00	1.85E-01	1.29E+01
SD022081	8.31E+03		7.25E+00		3.19E+02	4.03E+01	1.04E+02	1.65E+00	1.15E+02
SD022081	7.30E+02		3.00E+00		1.32E+02	1.67E+01	4.29E+01	7.75E+00	5.41E+02
SD022081	3.99E+03		9.00E+00		3.96E+02	5.00E+01	1.29E+02	4.26E+00	2.97E+02
SD022081	4.02E+04		1.60E+02		7.05E+03	8.89E+02	2.29E+03	7.51E+00	5.24E+02
SD022082	4.28E+03	U	3.92E-01		1.73E+01	2.18E+00	5.60E+00	1.73E-01	1.21E+01
SD022082	6.46E+03		3.12E+01		1.37E+03	1.73E+02	4.46E+02	9.11E+00	6.35E+02
SD022082	2.35E+03		7.20E+00		3.17E+02	4.00E+01	1.03E+02	5.78E+00	4.03E+02
SD022082	4.20E+03		6.60E+00		2.91E+02	3.67E+01	9.43E+01	2.96E+00	2.07E+02
SD022082	3.31E+04		7.40E+01		3.26E+03	4.11E+02	1.06E+03	4.22E+00	2.94E+02
SD022083	4.71E+03	U	2.92E-01	*	1.29E+01	1.62E+00	4.17E+00	1.17E-01	8.16E+00
SD022083	2.73E+03		2.35E+00		1.04E+02	1.31E+01	3.36E+01	1.62E+00	1.13E+02

Table 2

Comparison of Total PCB Concentrations to Sediment Guidelines

Location ID	Total Organic Carbon (mg/kg)		Total PCBs (mg/kg)		Hazard Quotient — NOTE: Hazard quotients represent the degree of exceedance				
					NOAA[a]		OMEE[b]		
					Effects Range-Low (ER-L)[c]	Effects Range-Median (ER-M)[d]	Lowest Effect Level (LEL)[e]	Severe Effect Level (SEL)[f]	SQG[g]
SD022083	1.24E+03		1.00E+00		4.41E+01	5.56E+00	1.43E+01	1.52E+00	1.06E+02
SD022083	4.49E+03		1.00E+01		4.41E+02	5.56E+01	1.43E+02	4.20E+00	2.93E+02
SD022083	4.31E+04		8.10E+01		3.57E+03	4.50E+02	1.16E+03	3.55E+00	2.47E+02
SD032101	4.48E+03	U	1.11E+00		4.89E+01	6.17E+00	1.59E+01	4.67E-01	3.26E+01
SD032102	4.48E+03	U	2.76E-01	*	1.21E+01	1.53E+00	3.94E+00	1.16E-01	8.09E+00
SD032103	5.03E+03	U	5.42E+00		2.39E+02	3.01E+01	7.74E+01	2.03E+00	1.42E+02
SD032121	1.21E+02	U	1.68E+00		7.40E+01	9.33E+00	2.40E+01	2.62E+01	1.83E+03
SD032122	1.12E+02	U	4.10E+00		1.81E+02	2.28E+01	5.86E+01	6.91E+01	4.82E+03
SD032123	3.92E+03		1.23E+00		5.42E+01	6.83E+00	1.76E+01	5.92E-01	4.13E+01

[a] Long et al., 1995.

[b] Persaud et al., 1993.

[c] ER-L (mg/kg DW) = 0.0227

[d] ER-M (mg/kg DW) = 0.18

[e] LEL (mg/kg DW) = 0.07

[f] SEL (mg/kg DW) = TOC dependent. SELs were converted to bulk sediment values by multiplying 530 mg PCB/kg OC by the sample-specific sediment FOC, to a maximum of 0.10.

[g] U.S. EPA, 1993. Bulk sediment SQGs were calculated using the approach defined in Table 1 and the sample-specific organic carbon content.

* Not detected. Sample was included at half the sample quantitation limit.

J = Estimated value.

NA = Not applicable.

U = Not detected. Value presented is the sample quantitation limit.